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SPECIAL NOTICE

TO CHIEF ENGINEERS OF CITIES AND TOWNS WHERE PAVEMENTS HAVE BEEN LAID BY COMPANIES CONTROLLING and RESTRICTING THE ASPHALT THEY USE UNDER LONG TERM GUARANTEES and where the guarantees have expired

Save the Money of Your City and Buy Your Asphalt from Us

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WITH THE ORIGINAL BUILDERS

UVALDE ASPHALT COMPANY

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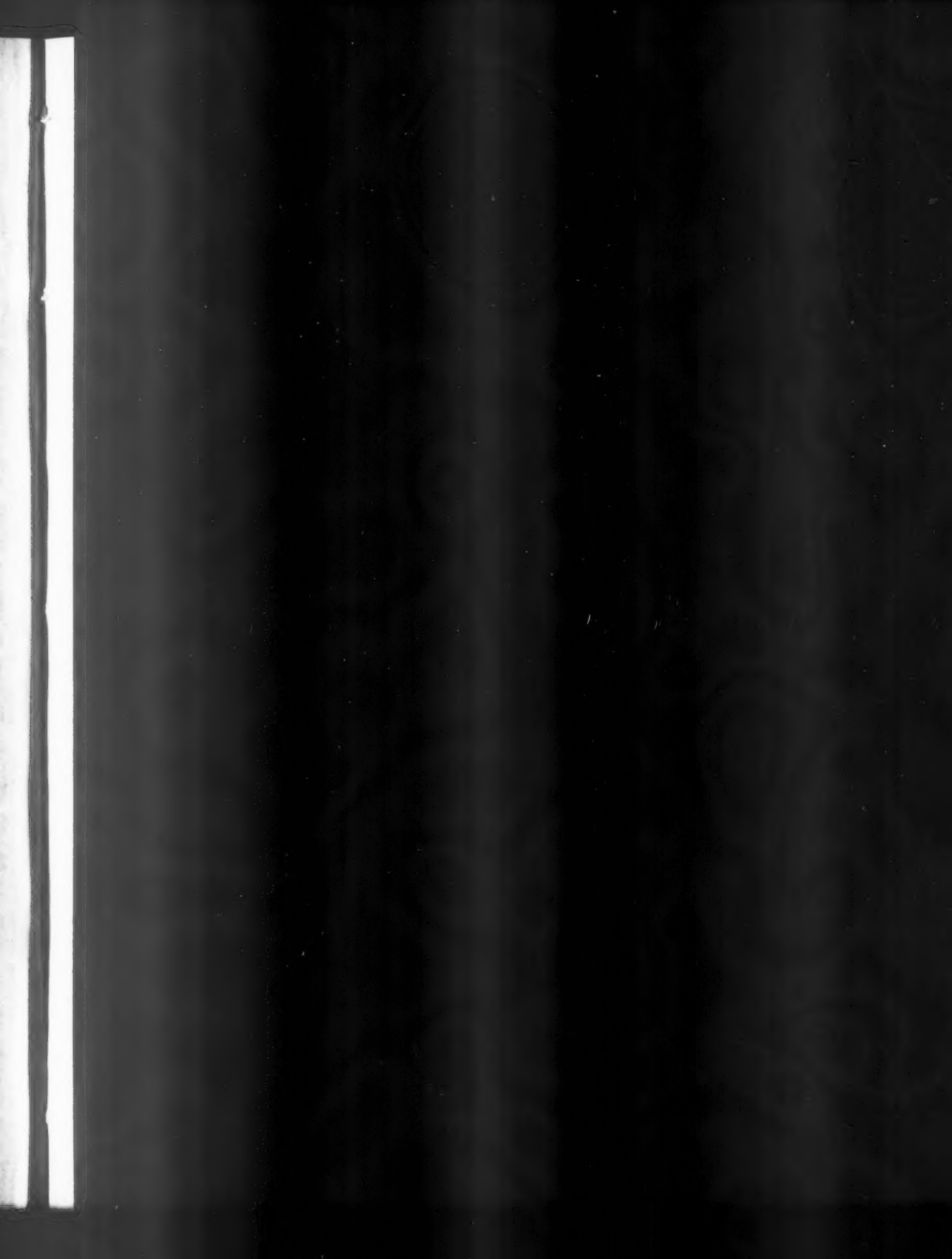


Municipal Engineering

VOLUME XX. MARCH, NINETEEN HUNDRED ONE. NUMBER 3.

REPAIRING ASPHALT PAVEMENTS IN CHATTANOOGA.

By Robt. Hooke, City Engineer.

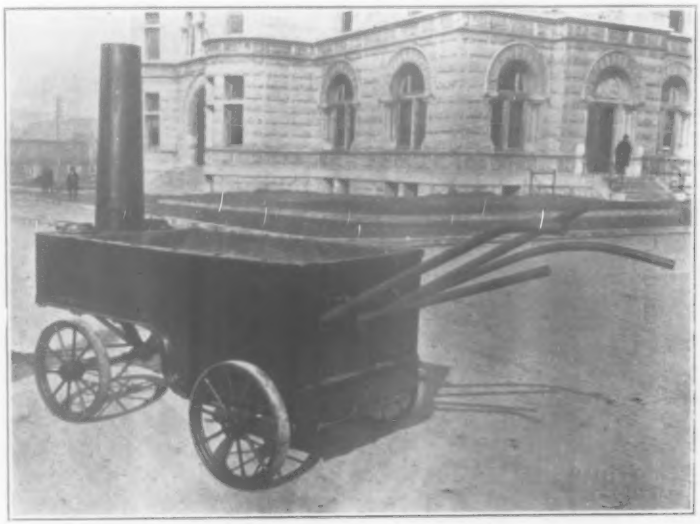
The beauty of a well-laid and properly cared-for asphalt pavement is admitted by all, and it is a justly popular pavement with all who, from observation and experience, have become familiar with its merits; but the objection is not infrequently heard, even from those who otherwise commend this pavement, that asphalt pavements are troublesome to keep repaired, as, it is claimed, only the skilled employes of the asphalt paving companies can make any repairs whatever, and that it is difficult to have the repairs made promptly after the expiration of the guarantees, when repairs become more frequently necessary. This is more especially true in the case of cities of the smaller class where no asphalt plant is maintained, and even where this is done, paving companies find it too inconvenient and expensive to send their working forces at frequent intervals to places where only limited repairs are required, and the result is that, in the case of the older pavements, holes appear from time to time which are left to become more extensive from day to day, until the arrival of the skilled workmen of the paving company, with which an arrangement has been made to execute the required repairs.

The city of Chattanooga has had considerable experience along this line. This city has 2.5 miles of sheet-asphalt pavements, on streets varying in width of roadway from 30 to 70 feet, the present age of which is from nine to twelve years, excepting three blocks on Market street, which were resurfaced last spring by the Barber Asphalt Paving Company. The guarantees on these pavements were, with a single exception, for a period of five years, and the expirations, therefore, occurred from four to seven years ago. After the termination of the guarantee periods, the Warren-Scharf Asphalt Paving Company, which laid the original pavements, visited the city about once a year with its skilled workmen and made all necessary repairs, at a cost to the city of $2, and finally of $1.80, per square yard, for resurfacing alone, the company having maintained a stationary plant here from the time its first pavement was laid in the city, in 1888.

In March of last year the Barber Asphalt Paving Company having resurfaced three blocks on Market street, of the pavement originally laid by the Barber Asphalt Paving Company, in 1888, had, after the completion of the work, about six tons of pavement mixture which had been prepared at its railroad plant, which had been brought here to do the Market street work. This pavement mixture, which was in blocks containing, perhaps, half a cubic foot, was purchased by the city with the intention of using it in making the repairs of the old pavements, which were failing in spots of more or less frequency, it being designed at the time to reheat this pavement mixture, as it was required for use, in a stationary pan, from which it was to have been transported by wagon to the street where the repairs were to be made. This plan, on further consideration, did not impress me favorably, as it would require men at the yard to look after the reheating of the pavement mixture, and three or more men on the street with the fire-wagons and tools, or else a great loss of time if the street force had also to attend to the reheating of the mixture: besides there would be more or less danger of the hot mixture cooling to too low a temperature, if the wagon containing it had to be driven some distance, and the small repairs were scattered over several streets.

It occurred to me that a portable heater for the pavement mixture, in which was combined a fire-wagon for heating the tampers, smoothing irons and asphaltic cement for painting the joints, was more desirable

than a stationary reheating pan and a separate fire-wagon on the street, and I accordingly communicated with the most extensive manufacturer of asphalt paving tools, for the purpose of ascertaining whether such a portable heater were manufactured, and, if so, to procure one for use in this city. I was informed that nothing of the kind was manufactured. I therefore designed what I subsequently named a combined fire-wagon and asphaltic mixture heater, and had one built at the boiler works of Walsh & Weidner in this city. This heater has been used from time to time from the first of last November, and to the present time, January 25, 349 square yards of repairs have been made, 71 of which were with the new pavement mixture obtained from the Barber Company, and the remainder, or 278 square yards, were with old material. Of this latter quantity 131 square yards were laid next to an electric railway track which had just been rebuilt, the asphalt pavement having been removed for a foot or more beyond the rails to permit the raising of the cross-ties, and the old asphalt that was taken up for this purpose was reheated and used again. The 218 square yards of ordinary repairs included 271 separate patches in the pavements, giving an average of 0.8 of a square yard to the patch, although some of the individual patches measured as high as eight or ten square yards. No roller was used on any of the work, which was finished with the tamper and smoothing iron alone, the men after a few days' work becoming quite skilled in the use of the tools.



ASPHALT HEATER AND FIRE WAGON.

There are probably few, if any, cities having asphalt pavements which do not sooner or later have portions of the asphalt removed in the construction of railroads, conduits or other work requiring the opening of the streets, and by reason of such removals of the pavement a supply of old material may be maintained, and this may be utilized in repairing old asphalt pavements by simply reheating it and adding a small quantity of residuum oil. In this city all of this old material was formerly thrown away, and many tons of it have recently been recovered, and utilized in the manner stated in repairing our older asphalt pavements, with indications, so far, of the most satisfactory results. This old material is of course, not so good as new pavement mixture, but it is not necessary that it should be when used to repair pavements that have been down for a number of years, as it is not important that the material used in such repairs should be superior in durability to the remainder of the old pavement; yet as this material receives an addition of residuum oil it is quite likely, in many instances, to be superior in durability to the average asphalt in the remainder of the street where the repairs are made. Old material in sufficient quantity may not always be on hand, and to meet such an emergency a supply of fresh pavement mixture should be procured from some asphalt paving company.

The illustration of the combined fire-wagon and asphaltic mixture heater is from a photograph of the one owned by the city

I. BRANCH BROOK PARK, NEWARK. A GARDEN VIEW.

of Chattanooga, after two months' use in the city, during which time about 300 square yards of asphalt repairs were made. The capacity of this heater is three square yards of two-inch pavement to each batch of material heated. The weight of the heater, with the pan empty, is about 1,900 pounds, but as it is provided with roller bearings, it may be readily drawn by three men up a three per cent. grade, or by one man, on a 0.5 per cent. grade, over an asphalt pavement. The photographic view shows how the machine is used as a tool heater, and at the forward end may also be seen the kettles in which is heated the asphaltic cement for painting joints. The material pan is in the form of a segment of a cylinder, and is made of one-quarter-inch steel plate. The outer shell is of No. 12 steel plate with an interior fire-box lining of cast-iron. The fire-box is provided with cast-iron grate bars, beneath which an ash-pan is provided. Dry wood is the fuel best adapted for the heater. The heater is now worked by a force of three trained laborers, who are regularly employed in the general street force in order that they may be at all times available for asphalt repair work.

If an asphalt pavement is to be repaired, and the area of the surface to be treated does not exceed three square yards, these three men are sent to the yard for the heater, the pan of which, after pouring in a quantity of water, they fill with the pavement mixture, usually old material, start the fire, fill a kettle with asphaltic cement, introduce a smoother and tamper, and then proceed to the street where the repairs are to be made. It requires about one and one-quarter hours to prepare a batch of old material for use, and the tools may be left on top of the heater until time to be introduced into the fire-box for heating. When more than one batch of material is required, a wagon is sent out with the heater, to which the latter is attached, for the purpose of taking a supply of material and fuel to the street. The capacity of the heater is six batches a day, or about 18 square yards when the work is confined to one locality, and the cost of such a day's work in Chattanooga is as follows:

Labor of 3 men at $1.10 per day each.	$3 30
Wagon and team 3 hours.....	75
Total.....	$4 05

If the work is scattered, the wagon and team may be required all day, which would increase the amount by $1.75, or make the day's work cost $5.80. If we add to this the cost of the fuel, residuum oil and asphaltic and hydraulic cement, we shall have a total cost of

For labor and team.....	$5 80
Fuel.....	70
Residuum oil and cement.....	1 00
Total.....	$7 50

This is the cost of the day's work of 18 square yards of resurfacing, not including anything for the old material, which would otherwise be of no value. The cost of labor in the northern cities would be higher than is paid here.

Two sizes will probably be made, one having a capacity of three, and the other of 4½ square yards of two-inch pavement to the batch. Where a considerable quantity of resurfacing is required, two heaters could be employed to advantage, as this would not only expedite the work but would lessen the cost of it per square yard. A patent upon the apparatus has been applied for.

COMPARISON OF COST OF ASPHALT PAVEMENTS.

In December, 1900, Mr. F. V. E. Bardol, chief engineer of the department of public works of Buffalo, New York, sent a circular letter to the cities of the country asking the questions indicated by the headings of the accompanying table, as applied to the year 1900. One caution is included in the following sentences from the letter:

"In some instances the average price for all contracts let might not represent the prevailing rate. If this is the case in your city, I would prefer to have the average of only those streets which were done under normal conditions."

Several cities reported no asphalt laid and several others reported that no asphalt was laid under normal conditions. These are omitted from the table, as well as those the data from which were insufficient to make the reduction to the Buffalo conditions.

Mr. Bardol very kindly furnishes us with the following statement of the bases upon which the corrections to the reported prices are made to reduce them to an equality with the conditions in Buffalo:

"As to concrete, there are a number of apparent discrepancies between the prices submitted per cubic yard and the unit

COST OF ASPHALT PAVEMENTS INCLUDING BASE, BINDER, WEARING SURFACE.

Compiled by F. V. E. Bardol, Buffalo, N. Y., January, 1901.

CITY.	Average price for 1900, including concrete, binder and wearing surface.	Thickness of concrete.	Proportions of concrete.	Cost of concrete per cubic yard.	Correction for concrete, Buffalo specifications.	Kind of cement.	Cost of cement per bbl.	Cost of sand per cu. yd.	Cost of broken stone per cubic yard.	Depth of binder.	Correction for binder, Buffalo specifications.	Thickness of wearing surface.	Correction for wearing surface, Buffalo specifications.	Period of guarantee.	Correction for guarantee, Buffalo specifications.	Hours of labor.	Prevailing rate of wages, common labor.	Correction for labor, Buffalo rates.	Price per sq. yd. reduced to Buffalo specifications. (See foot-note.)	City Engineer.
Altoona	$2 47	6″	1-2-5	$4 20	—.14	Natural	$0 80	$1 55	$1 68	1″	+.10	1½″	—.19	5 yrs.	+.15	10	$1 60	+.04	$2 81	Harvey Linton.
Atlanta	2 83	6″	1-2-4	4 50	—.10	“	1 00	75	1 25	1½″	0.00	1½″	+.19	10 “	0.00	10	1 00	+.10	3 02	R. M. Clayton.
Baltimore	2 18	6″	1-3-5	3 30	0.00	“	1 00	75	1 50	1½″	0.00	2″	0.00	5 “	+.15	8	1 66	0.00	2 33	B. T. Fendall.
Boston	3 25	6″	1-3-7	4 50	—.24	Portland	2 50	1 30	1 70	1½″	0.00	1½″	+.19	10 “	0.00	9	1 75	0.00	3 20	B. T. Wheeler.
Brooklyn	3 15	5″	1-3-6	5 63	—.17	Portland	2 20	$.75 to $.80	1 60	1″	+.10	2″	0.00	10 “	0.00	8	1 50	0.00	3 08	Geo. W. Tilson.
BUFFALO, N. Y.	2 20	6″	1-2-5	3 30	.....	Natural	70	$1 25	1 10	1½″	.....	2″	.....	10 “	.....	8	1 50	.....	2 20	F. V. E. Bardol.
Chattanooga	2 68	6″	1-2-5	.....	0.00	“	.....	.....	.....	.....	.....	2½″	—.19	5 “	+.15	.....	.....	.....	2 64	Robt. Hooke.
Cincinnati	2 05	6″	1-2-6	2 60	—.03	“	60	75	1 35	†1½″	+.10	2″	0.00	5 “	+.15	10	1 50	+.05	2 32	H. J. Stanley.
Cleveland	2 17	6″	1-2-4	.....	.00	“	.....	.....	.....	1″	+.10	2″	0.00	10 “	0.00	.....	.....	.....	2 27	James Ritchie.
Columbus	2 20	6″	1-2-4	3 00	—.11	“	80	1 00	1 10	1″	+.10	2″	0.00	10 “	0.00	10	1 50	+.05	2 24	J. Griggs.
Denver	2 13	6″	1-2-4	4 50	—.20	“	1 25	50	2 00	1″	+.09	2″	0.00	5 “	+.15	8	1 60	0.00	2 17	W. P. Jones.
Des Moines	1 96	4½″	1-2-4	.....	+.10	“	.....	40	1 25	1″	+.10	1½″	+.19	7 “	+.09	10	1 75	+.02	2 46	G. E. Eberhart.
Fort Wayne	2 40	6″	1-2-5	.....	0.00	“	.....	65	1 15	1½″	0.00	2″	0.00	10 “	0.00	10	1 50	+.05	2 45	F. M. Randall.
Kansas City	2 12	5″	1-2-5	.....	+.03	“	.....	80	1 00	1½″	0.00	1½″	+.19	10 “	0.00	8	1 40	+.03	2 37	R. M. Waddell.
Lafayette, Ind	2 00	6″	1-2-6	4 00	—.11	Portland	.....	.....	.....	1″	+.10	1½″	+.19	10 “	0.00	10	1 50	+.05	2 23	W. K. Eldridge.
Los Angeles	1 80	6″	1-3-6	6 00	—.21	“	2 50	40	1 00	No	+.28	2″	0.00	No	+.18	10	2 00	—.01	2 04	F. M. Olmstead.
Milwaukee	1 85	6″	1-2-5	.....	+.04	Natural	55	65	1 10	1″	+.10	2″	0.00	5 “	+.15	10	1 50	+.05	2 19	C. J. Poetsch.
Montreal	3 25	6″	1-3-4	6 00	—.45	Portland	2 84	75	1 25	⅛″	+.19	2½″	—.19	10 “	0.00	10	1 25	+.07	2 87	John R. Barlow.
New Orleans	2 50	6″	1-3-7	8 00	—.40	“	.....	2 02	2 02	1½″	0.00	2″	0.00	5 “	+.15	10½	1 50	+.05	2 30	W. J. Hardee.
Newport News	2 63	6″	1-2-5	4 80	—.25	Natural	95	50	2 20	1½″	0.00	1½″	+.19	10 “	0.00	10	1 25	+.08	2 65	T. C. Hatton.
New York	2 55	6″	1-3-6	5.837	—.15	Portland	2 50	45	.....	1″	+.10	2″	0.00	10 “	0.00	8	2 00	—.07	2 44	Jacob Wund.
Omaha	2 11	6″	1-2-5	5 00	—.03	Natural	$.85 to $.75	$.65 to $.75	$1.35–$1.45	1½″	+.00	1½–2″	+.10	5 “	+.15	10	1 65–1 85	+.02	2 35	A. Rosewater.
Peoria, Ill.	1 96	6″	1-1½-4	4 50	0.00	“	55	1 00	1 50	1″	+.10	1½″	+.19	5 “	+.15	10	1 50–1 75	+.02	2 42	H. E. Beasley.
Pittsburg	2 44	6″	1-2-4	.....	—.15	“	70	65	1 70	1″	+.10	2″	0.00	5 “	+.15	9–10	1 50–1 60	+.04	2 58	G. W. Wilson.
Providence, R. I.	2 65	6″	1-2-6	5 10	—.29	Portland	2 20	.50 to .75	2 00	1½″	0.00	1½″	+.19	5 “	+.15	10	1 50–1 75	+.05	2 75	O. F. Clapp.
Rochester, N. Y.	2 11	6″	1-2-4	4 00	—.05	Natural	70	1 00	1 10	1″	+.10	2″	0.00	10 “	0.00	8	1 50	0.00	2 16	E. A. Fisher.
San Antonio*	1 99	6″	1-2-4	4 40	—.18	“	1 50	1 00	75	No	+.28	2″	0.00	10 “	0.00	8	1 50	0.00	2 10	E. G. Truhart.
San Francisco*	1 89	6″	1-2½-7	4 86–5 50	—.25	Portland	2.75 to 3.00	70	1.25 to 1.50	No	+.28	2½″	—.19	No	+.18	9	2 00	—.03	1 88	E. G. Morser.
Scranton	2 20	6″	1-3-7	4 20	—.17	“	1.80 to 2.00	1 00	1 25	1½″	0.00	1½″	+.19	10 “	0.00	10	1 50	+.05	2 27	Jos. T. Phillips.
Spokane	2 29	4″	1-3-6	7 65	—.30	“	4 50	70	.95 to 1.00	1½″	0.00	2″	0.00	10 “	0.00	8	1 60–2 00	—.03	1 96	Otto A. Weile.
St. Paul	2 55	6″	1-2-4	3 00	0.00	Natural	.....	.....	.....	1″	+.10	2″	0.00	10 “	0.00	10	1 50–1 75	.....	2 65	O. Clausen.
Toledo	1 96	6″	1-2-5	.....	0.00	“	.....	.....	.....	1″	+.10	2″	0.00	5 “	+.15	10	1 50	+.05	2 26	Wm. F. Brown.
Toronto	2 75	6″	1-3-6	5 40–6 00	—.24	Portland	2 24	79	1 60	⅝″	+.14	2½″	—.19	10 “	0.00	9	1 62	0.00	2 46	C. L. Fellowes.
Utica	2 35	5″	1-2-5	4 00	+.07	Natural	85	.70 to 1.00	1 25	1″	+.10	2″	0.00	10 “	0.00	8	1 50	0.00	2 52	P. L. Schultze.
Washington, D. C.	1 79	6″	1-2-5	3 50	—.07	“	70	40	1 25	1½″	0.00	1½″	+.19	5 “	+.15	8	1 20	+.05	2 11	C. B. Hunt.
Winnipeg	1 79	4½″	1-3-6	5 74	—.30	Portland	3.65 to 3.80	1 00	1 10	1½″	0.00	1½–2″	+.09	.....	+.18	9	1 53–1 80	0.00	1 76	H. N. Ruttan.

The price given in column of price per square yard reduced to Buffalo specifications is obtained by reducing the specifications and prices from the respective cities to Buffalo specifications and prices, assuming that the cost of guarantee for the first 5 years is 3 cents per yard and for the second 5 years is 15 cents per yard. Total, 18 cents per yard.

Average of reported prices is $2.28 per square yard; average of corrected prices is $2.41 per square yard, the price for Buffalo being $2.20 in each case.

*Bituminous rock asphalt. †Cushion.

prices for the concrete ingredients. In these cases the cost of concrete, exclusive of labor, was figured out from the unit prices. The difference between the price per square yard obtained and the Buffalo price represents the correction.

"The cost of material for binder 1½ inches in depth is taken at 25 cents per square yard. The correction for a different depth is derived by proportion.

"The cost of wearing surface 2 inches in depth, exclusive of labor, is taken at 77 cents per square yard.

"Correction for guaranty is made on the assumption that the cost of guaranty for the first 5 years is 3 cents a yard and for the second 5 years is 15 cents a yard, making a total cost for 10 years of 18 cents.

"Labor in making concrete binder and wearing surface is assumed at 20 cents a square yard in Buffalo."

It will be noted that the average of the reported prices is $2.28 and the average of the corrected prices is $2.41 per square yard, the price for Buffalo being $2.20 in each case.

This attempt to reduce prices to a uniformity of conditions is very interesting and instructive. It is a valuable contribution to the study of asphalt paving. While all may not agree with the author of the table in some of his judgments, the figures are given in sufficient detail to enable each engineer to make the changes which fit his own experience and to continue the investigation on his own lines. Discussion of some of the questions arising will be found in our editorial columns.

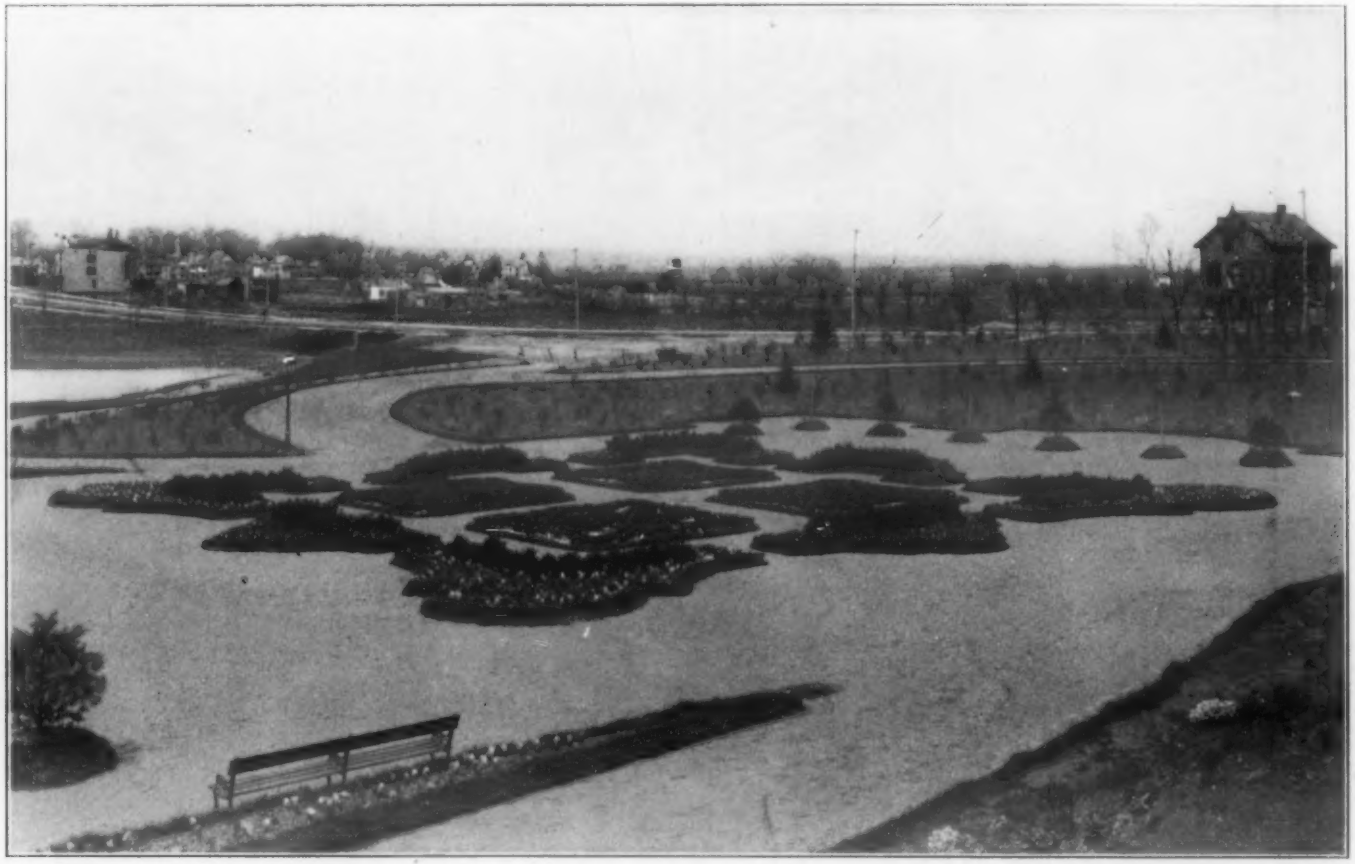
BRANCH BROOK PARK, NEWARK, N. J.

We present this month a series of interesting views of the progress of work on Branch Brook Park, Newark, New Jersey, under the direction of the department of parks of Essex county. The park is a long, narrow strip of land of varying width, having a total length of 11,115 feet and an average width of 1,175 feet, being but 685 feet wide at the narrowest part of the main park, and averaging only 268 feet wide in the long, narrow entrance at the southern end. The southern portion of the park site is surrounded by a dense population, and while the adjoining land about the northern portion is now less thickly settled the near future will see the whole park surrounded by an urban district. These facts have decided the question of plan in favor of a detailed and somewhat formal treatment of trees, shrubbery, beds, lawns, drives and walks, giving the park a formal beauty which will aid in inducing the people to preserve its features intact. Work has begun in the southern portion and all our views are taken in the southern division.

Two views show garden views and the formal type of this portion of the plan. These are in older portions of the park and show the areas as they were in the summer of 1899.

Several views show the features of the lake in this division of the park. One gives the mound, with shelter-house for use during showers, located on the east side of the lake: another, a view of the use of the lake for skating, taken on New Year's day, 1900. Two views show the improvement near Clifton and Seventh avenues, one taken in 1896, and the other in 1899, after houses had been removed and park grading and planting had been done. The new high school building, erected at the edge of the park, adds to the value of the improvement. Two views show the method of separating the drive in the park, east of the lake, from the walk, saving a grade-crossing, one view being taken in 1897 of the site of the archway, and the other of the completed arch, in 1899. It will be noted that the side slopes have not yet been put in shape.

All the views show the restricted dimensions of the park and indicate its value to the large population within easy reach of it. The impossibility of isolating the park by treatment of its borders is shown, and the consequent necessity of the plan which has been decided upon. Work is in progress upon the other divisions of the park. It is one of a series of small, medium-sized and large parks and reservations under the control of the commission, the improvement of which will take some years of close application. We are indebted to Mr. Howard J. Cole, engineer-in-chief, for the opportunity to present the graphic report of the progress of the work.



II. BRANCH BROOK PARK, NEWARK. THE ENGLISH GARDEN.

HEATING FROM CENTRAL STATIONS—A COMPARISON WITH PRIVATE HEATING PLANTS.*

By Alton D. Adams, M. A. I. E. E.

Heat is a form of energy which each consumer can produce for himself with a minimum of technical skill and investment for equipment. It may therefore be questioned, at the start, whether central heating stations have inherent advantages over the individual plants of consumers, which warrant their existence. The equipment of a central heating plant, to serve a large number of buildings, seems quite likely to cost as much or more, including the distribution system, as would the necessary number of small boilers, furnaces and stoves to heat the several premises.

It is well known that the production of heat on a large scale results in a very material economy of labor per unit, but it is also a fact that much of the labor required in private heating plants represents no addition to the expense for the care of buildings where they are located, beyond that necessary if heat be derived from an outside source. In the larger buildings of a city, however, there is quite sure to be some saving of labor if heat is derived from a public supply.

In the main, it appears that central heating stations can only hope to receive in payment for their service about the cost of fuel that would yield an equal amount of effective heat if consumed in the individual buildings. If this be true, the success of public heating plants must rest in a large measure on their ability either to deliver to consumers a larger part of the total heat of the fuel burned than could be secured from private equipments, or else to utilize fuel that costs less per unit of heating capacity than that used in buildings. There is no doubt as to the advantage of the large heating station over the private plant in the cost of fuel per unit of contained heat. This advantage rests on two causes, the ability of the heating station to buy fuel at cheaper rates, because much larger quantities are purchased than for the private plant, and to burn a lower quality of fuel than that required in most residences and many other buildings. The central heating station by a combination of chimney and mechanical draught is able to burn fine sizes of both anthracite and bituminous coal, that are entirely unsuited for use where only a moderate amount of natural draught is available. Bituminous coals with large per cents. of volatile matter are not suited for use in ordinary stoves and boiler furnaces, and their tendency to produce smoke is also a serious objection to their general application in residences and city buildings. The smoke from a large heating station, being conducted high into the air by a tall chimney, is far less objectionable than it would be if ejected by a large number of low stacks. A result of these conditions is that heating plants of small and medium size in residence and business buildings must often pay two or three times as much for their fuel per unit of heating power, as does the central station.

In addition to its advantage as to the first cost of fuel, the central heating station has another in its ability to supply a greater useful heating effect to consumers from the combustion of a given amount of fuel than they would derive by burning an equal amount of fuel in local heating apparatus. It has been stated that the independent heating plant may deliver as much as 62 per cent. and the combined electric and heating station nearly 50 per cent. of the total heat energy of coal to the premises of consumers, when the loss from distribution pipes does not exceed 20 per cent. of the heat entering them. The higher figure, 62 per cent., corresponds to the total, useful energy derived from the fuel, while the 50 per cent. of the fuel energy delivered in steam or hot water from electric stations is only a part of the products. With coal of 13,000 heat units per pound, the efficiency of 62 per cent. for an independent public heating system corresponds, in heat delivered to consumers per pound of fuel, to an evaporation of 8.3 pounds of water from and at 212 degrees in local boilers for each pound of coal burned. This rate of evaporation is attained in only a small per cent. of the best private heating plants, and it is not uncommon to find an evaporation not more than one-half this rate. A delivery to consumers of one-half of the heat energy in fuel burned at electric stations yields as much heat in buildings as would be derived from the same coal in local plants by an evaporation of 6.73 pounds of water from and at 212 degrees per pound of coal. Even this last result is decidedly above the average for small private heating equipments.

Leaving the saving of labor in private heating plants, by the use of steam or hot

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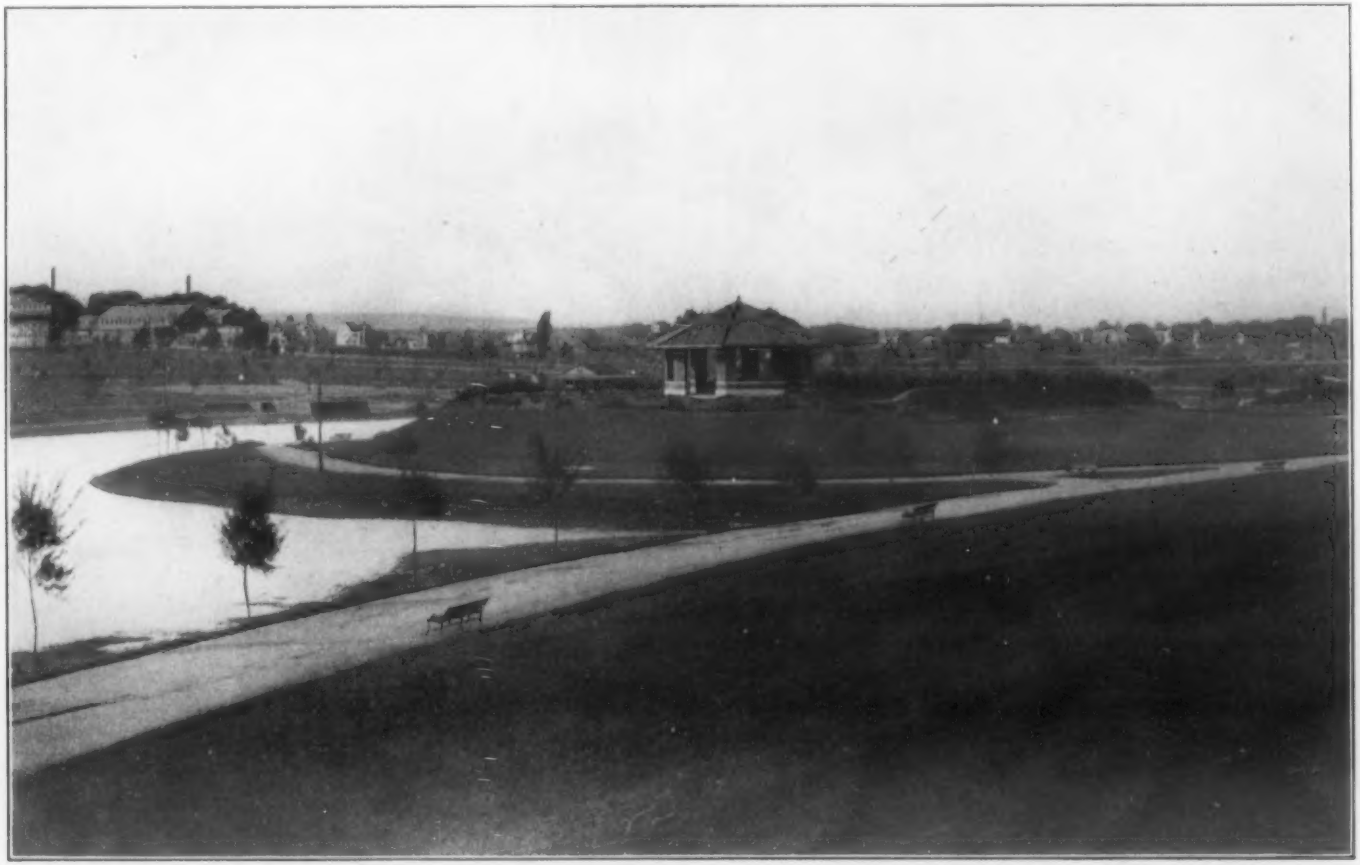


III. BRANCH BROOK PARK, NEWARK. SHELTER ON MOUND EAST OF LAKE.

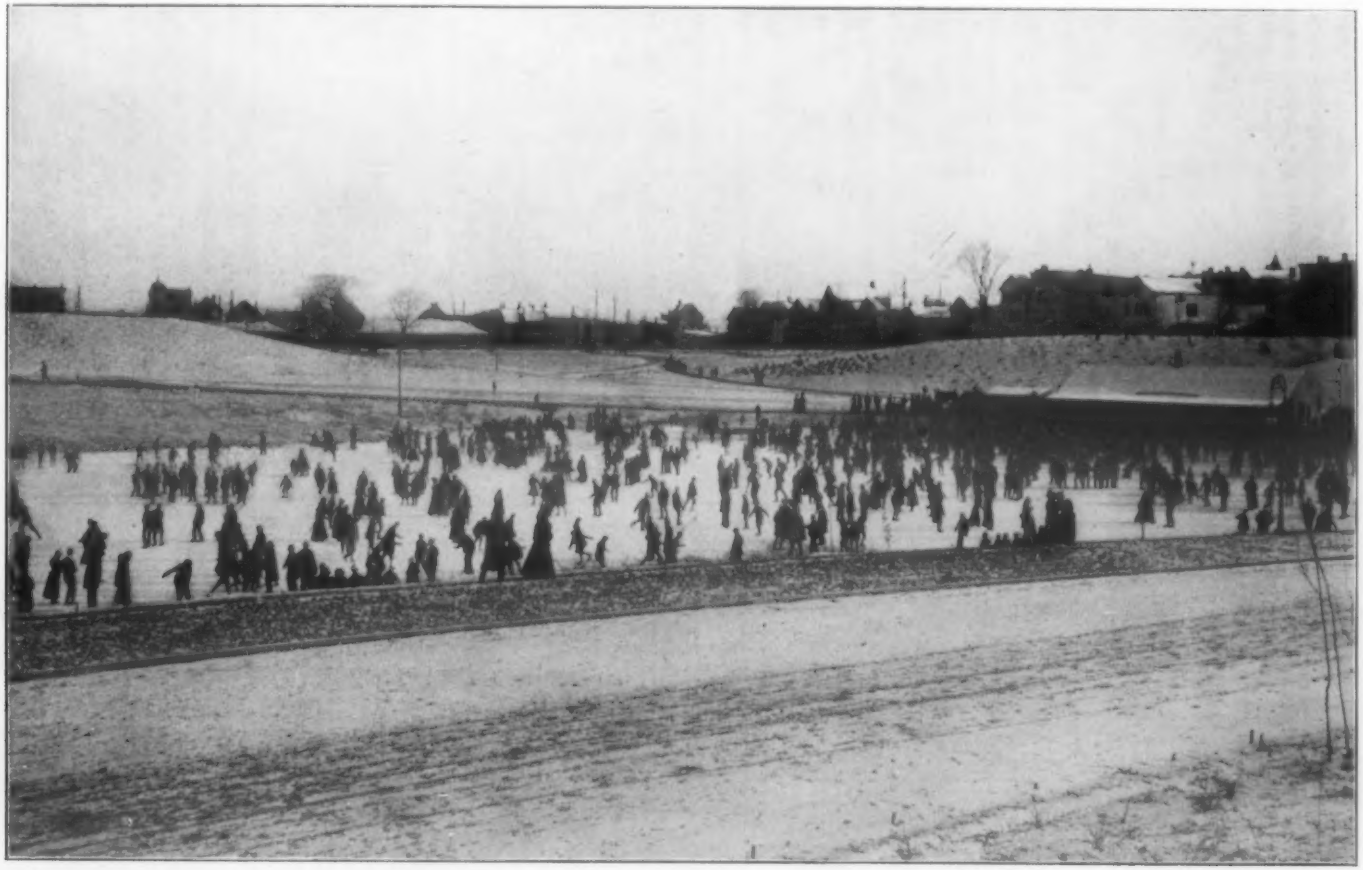
water from a public supply, as an inducement to the change of service, the central station may expect to receive for its heat the cost of the fuel it displaces at the premises of consumers. The stations devoted entirely to the distribution of heat should receive in any case a rate equal to the value of the coal burned in the station boilers at the price that coal of equal heating power costs consumers. The advantage of the station for this last case is determined by the price to it of a heat unit in fuel, compared with the price of a heat unit in fuel to the private plants.

For much of its service the heating station, by reason of its higher efficiency, might obtain the cost to the private plant of twice the weight of coal burned at the station to effect the delivery of a given amount of heat. Combined electric and heating stations, delivering only one half of the total heat of coal to consumers, may usually obtain a sum for service greater than the cost to private plants of the weight of coal burned at the station.

One pound of exhaust steam at atmospheric pressure contains 966 units of latent heat. If an electrical station delivers 30 pounds of exhaust steam, or water to which its latent heat has been imparted, per kilowatt hour to distribution pipes in which a loss of 20 per cent. occurs, consumers receive 23,184 heat units per kilowatt hour of electric output. This amount of heat may be obtained by the combustion of six pounds of coal in a local boiler furnace that evaporates 4 pounds of water from and at 212 degrees per pound of coal. With coal at $5 per ton at private plants, 6 pounds cost 1.5 cents. If the electric station delivers one-half of the total heat of coal to consumers as steam or hot water, only 3.56 pounds must be burned at the station to supply the 23,184 heat units in buildings, and this at $2 per ton costs 0.35 cent, or less than one-quarter of the value of coal to produce equal heating effect when burned in local furnaces. Provided 10 pounds of steam are necessary for each cubic foot of heated space during a season of eight months, the exhaust from an output of 416.6 kilowatt hours is required to heat 1,000 cubic feet. As the exhaust from 1 kilowatt hour displaces coal costing 1.5 cents in the local furnace, the season price to heat 1,000 cubic feet of building space may be 6.25 dollars. From the sale of heat in exhaust steam, electric stations may receive 1.5 cents per kilowatt hour of electrical output, with a steam plant that furnishes only 30 pounds of exhaust steam per kilowatt hour. As the steam consumed by the engines increases per unit of electrical energy, the corresponding heat for distribution and its value grow larger.

It is by no means necessary, however, that an electric station limit its heating business to what can be done with the available exhaust steam. One of the most serious disadvantages, under which electric stations have operated, is the great excess in the capacity of equipment over that necessary for the average load. A result is that much of the steam plant is in operation at such stations during only three or four hours per day, and the item of fixed expenses is necessarily a large one in the charges for electric energy. Fortunately for the combination of electric and heating supply from a single station, the maximum demand for heat is in the former and that for electric energy in the latter half of the day. It is thus possible for an electric central station to do a large business in the supply of hot water or steam directly from the same boilers that are used for the electrical output, in addition to what can be done with exhaust steam. Instead of the 11 per cent. of fuel energy, that central stations devoted exclusively to the production of electric current may distribute, the combined electric and heating plant is able to deliver to consumers more than 55 per cent. of the energy contained in coal, by the supply of electricity and the heat of exhaust.

An addition of heat distribution to the business of electrical stations, thus effects a large reduction in both the fuel item and fixed expense per unit of energy delivered. The income from the sale of heat should warrant a reduction in the charges for electric energy, that would be certain to result in a larger demand. An electric station that distributes 55 to 60 per cent. of the energy in fuel consumed, for either heat, light or power, is obviously in a much stronger position to compete with gas and isolated electric plants than the independent central stations that send out only 11 per cent. of the energy of the coal.



IV. BRANCH BROOK PARK, NEWARK. SKATING ON THE LAKE.

GARBAGE AS FUEL FOR STEAM PRODUCTION.

By W. L. Hedenberg, New York City.

To find some inexpensive and sanitary method of disposing of the garbage and other refuse which daily accumulates in towns and cities, is a problem that municipal officials have been endeavoring to solve for some time. In many localities the daily accumulation of refuse has been used for filling in low land, while in others situated on the coast it has been barged away at considerable expense to be dumped at sea, only too frequently to be in part brought back by wind and tide to the very shore from which it was taken. The plan of filling in low land with the contents of the garbage pail proved anything but healthful to a community, and, as in the case of Rider's Island near New York City, had to be given up.

An attempt was then made to burn the refuse after removing from it everything having a commercial value, such as tin cans, rags, etc. This was a step in the right direction from a hygienic standpoint, but still left much to be desired in a financial way. In the writer's opinion municipalities in this country have not given the method of garbage disposal now in vogue to a considerable extent in England sufficient attention. Our British cousins have gone a step farther than we have and not only burn the refuse in specially constructed furnaces, but utilize the heat derived from this low grade fuel for generating steam, which may be utilized for heating water for bathing purposes or for operating machinery. It may truthfully be said that a properly designed refuse destructor is at present the only known means of refuse disposal that satisfies both sanitary and economical requirements.

There are a large number of these plants scattered through Great Britain, the most important, however, being those at Shoreditch, Ealing, Oldham, Woolwich, Darwen, Bradford, Norwich and Cambridge. All these destructors are located in the heart of the community in which they are situated, which would certainly make them a public nuisance if disagreeable odors were given off, due to the incomplete combustion of the refuse. No complaints have of late arisen on this score, so it is said, as the gases given off by the burning matter are thoroughly oxidized before being admitted to the open air, by being obliged to pass through the hottest part of the furnace, which is kept at a temperature of 1,500 to 2,000 degrees Fahr.

Probably the most interesting of the various destructor-plants in operation is that at Shoreditch, situated, as it is, in a vestry of London. The station, located in the center of the parish, is well situated, both for the delivery of the refuse and for the distribution of the resulting power. The destructor-house, about 80 feet square, contains twelve destructors, six boilers of the water-tube type and a Halpin thermal storage cylinder, 35 feet long and 8 feet in diameter. The boilers are sandwiched between the destructors, and thus the radiation losses are minimized.

The furnaces or cells, as they are called, are charged from electrically-driven charging trucks, and are estimated to consume from 8 to 12 tons of refuse per cell per day.

The electrical plant driven from these furnaces consists of three 160-kilowatt direct-connected generators at 1,100 volts, and three of 70 kilowatts at 165 volts. There is also a motor-generator of 60 kilowatts capacity which may be used to develop either low or high pressure currents.

The station supplies for public lighting 57 arc lamps until midnight, which are thereafter replaced by incandescent lamps. Several small sub-stations having rotary converters to transform the high-potential alternating transmission current to low-potential direct currents are also supplied. The total number of lamps in operation (16 C. P.) is said to be 5,000. The cost of the installation was about $350,000.

The furnaces have provision for the use of coal instead of refuse, but it is not intended, nor has it been necessary, to resort to this, except on Sundays and other holidays, when there is no collection or delivery of refuse.

Probably the most vital and important portion of these plants is what is known as the Halpin thermal storage system, which consists in heating water to a high temperature under pressure, which permits of the utilization of the energy thus stored in the form of steam at any rate desired. For this purpose large iron cylinders are made use of in which water is superheated when the load on the station is light, to be drawn on during the busy hours.

That this type of garbage disposal plant is the ultimate solution of the problem of refuse disposal for towns and cities there would seem little doubt, as it combines a means of ridding a community of garbage

V. BRANCH BROOK PARK, NEWARK. FROM CLIFTON AND SEVENTH AVENUES, 1896.

in the most sanitary manner possible, at the same time with no financial loss; in fact, usually the reverse, as the clinker that remains after combustion makes an excellent substance for mortar or concrete, for which there is a growing demand. It was expected that at Shoreditch, a community numbering a hundred and twenty-five thousand inhabitants, a saving of $30,000 a year would be effected over the previous method of barging the refuse away, and although this hope has not been fully realized, according to the latest figures given out there is a small balance of something like $1,500 on the right side of the ledger.

In the United States, ordinarily, ash-bin refuse will amount to from one to four tons per inhabitant per year, and as such refuse has, according to a recognized authority, a calorific value about one-fifth that of ordinary coal, in a city having an assumed population of 200,000, producing an average of two tons per capita of refuse a year, there would be, theoretically, an equivalent of 80,000 tons of coal, representing an amount of energy equal to 40,000,000 horse-power hours. Of course the above results are merely theoretical and not obtainable in actual practice, but in any case, and allowing there is only a very small profit, as in the case of Shoreditch, the refuse should be burned for sanitary reasons alone, and any profit resulting from the utilization of the heat will be clear gain.

EDITORIAL COMMENT.

Development of Methods of Cement Manufacture.

The enormous development of the cement industry in this country during the last few years is due to two causes. One is the increase in density of population and the consequent increase in the amount of work in which cement has long been used and the great extension of the number of uses to which cement can be put; and the other is the development of labor-saving processes for manufacture which reduce the cost, so that cement can be used for many constructions from which it has been largely excluded on account of the relative cheapness of other materials.

The intermittent vertical kiln, similar to the lime kiln, was first used in burning natural cement, perhaps as early as 1823, in this country. It was soon followed by the continuous kiln, of similar type, but with more than double the capacity, because no time was lost in cooling the calcined material and recharging and refiring the kiln. The comparatively low temperature in these kilns is sufficient for the calcination of the natural cement rock; in fact, a higher temperature injures the product from some deposits of cement rock.

The Portland cement industry developed in other countries, notably in England, France and Germany, using chalk or limestone and clay as materials. Intermittent kilns like the dome kilns, continuous kilns like the Dietzsch, and ring kilns like the Hoffman were used, the high temperatures necessary for complete calcination of the exact mixture necessary for Portland cement being obtainable in the special combustion chambers or by the methods of charging and burning. With the very best of care, however, it was impossible to secure uniform calcination of all the product of the furnace and very careful selection of clinker was necessary that the cement be uniform. This necessitated much hand labor with a certain expertness, and with the vast amount of labor necessary in making bricks, drying them and depositing them in the kiln and the many handlings between, made a total which, under American conditions of labor, insured a price too high to compete with cement produced with the cheaper labor of Europe.

Notwithstanding this and the entire difference in materials, Mr. D. O. Saylor conceived the idea of making Portland cement by European methods, modified to make them fit the materials he had, viz: the natural cement rock of the Lehigh region and limestone. After years of experimenting he succeeded in making a high grade of Portland cement by mixing the two kinds of rock in proper proportions, and by introducing labor saving devices and improved machinery was able to compete in the American market with foreign cements, with some help from the tariff, except where the prejudice in favor of foreign cement, at any price could not be overcome.

Ten years after Mr. Saylor made his first Portland cement Ransome patented in England and the United States the rotary kiln, using gas for fuel, but with the small kilns used and the previous treatment of raw material it was a failure. The Atlas Portland Cement Company took up the kiln, and with the more favorable hard and dry materials of the Lehigh valley finally

VI. BRANCH BROOK PARK, NEWARK. FROM CLIFTON AND SEVENTH AVENUES, 1899.

made a success of it. Crude oil was later introduced for fuel and the present tendency is to use finely powdered coal.

With the success of this kiln the development of the Portland cement industry in this country began in earnest. It is possible to carry the material from the raw material cars to the finished package of cement without any handling, and this great reduction in the cost of labor enables the American manufacturer to compete successfully in price with any country in the world.

In 1892 the Warner Portland Cement Company tried the perfected kiln upon wet slurry, obtained by the mixture of marl and clay in pug mills, instead of drying and pulverizing bricks made of it and attempting to calcine this dust according to the method which failed in England. This was successful, and the development of the manufacture of cement in Northern Ohio and Indiana, and in Michigan, is due to this success, the wet material fed in at one end of a 60-foot kiln coming out at the other perfectly calcined Portland cement clinker of the size of peas.

One feature of the rotary kiln process is the absolute uniformity with which the clinker can be calcined. The introduction of variable speed apparatus puts the kilns under the absolute control of the expert in charge of them, and he can determine exactly the rate and amount of calcination the material shall receive.

The capacity of the rotary kilns in use averages about 125 barrels a day, say six times the capacity of the old intermittent kiln. They require more than twice the fuel of the continuous vertical kiln per barrel of product, so that there is some offset to the saving in labor cost.

Another branch of the process in which there has been great improvement is the grinding of clinker and, where required, of the dry raw materials. There are two general classes of mills; those in which the fine dust is separated from the partly ground material, the latter being returned to the mills; and those in which the process is continued long enough to turn out the finished product of sufficient fineness. There are indications of still further improvement in this direction in the near future in regard to cheapness of operation. It is difficult to conceive of a better result so far as fineness and uniformity of grinding is concerned, any desired degree of pulverization being attainable.

The "Directory of American Cement Industries and Hand-book for Cement Users," which is in preparation by Municipal Engineering Company, gives details of the application of these methods in the various cement manufacturing plants in the country.

Requirements For Cement In the report of W. A. Rogers to the Association of Railway Superintendents of Bridges and Buildings upon concrete are two tables of the requirements made by the railroads of the cement to be used on their work. For natural hydraulic cement the specifications vary from 50 to 75 pounds tensile strength neat in one day, the lower figures being the more popular, and but one requiring 75 pounds; from 90 to 130 pounds is required in 7 days; but two give a 28-day test of 150 pounds. For mortar one cement to one sand, one requires 50 pounds in one day and 120 pounds in 7 days; for one cement to three sand, specifications are few, and range from 20 to 27 pounds in one day, 30 to 40 pounds in 7 days, and 56 to 70 pounds in 28 days. For fineness the popular requirement is 90 per cent. through a No. 50 sieve, varying from 88 to 95 per cent., and one requires 75 per cent. through a No. 100 sieve. Six require the cold pat test.

For Portland cement the requirements are quite as varied, in tensile strength running from 100 to 200 pounds neat in 24 hours, from 260 to 400 pounds in 7 days and from 400 to 500 pounds in 28 days. Very few require sand tests, and the maxima are 175 pounds in 28 days for one cement to two sand, and the same for one cement to three sand.

Fineness varies from 85 to 95 per cent. on a No. 100 sieve, with the majority for 90 per cent. Four require the cold pat test and three the boiling test.

Most of the replies to the request for cement specifications were met by the statement that none were required.

But three or four of the roads reporting have what approximate to adequate modern specifications for either natural or Portland cement. Since this is perhaps the most important single material entering into the structures under supervision, such neglect of precaution against receipt of poor material is somewhat surprising. It is doubtful, however, if municipal work will show much better practice, except where the smaller cities model their specifications for public work upon those in neighboring large cities. While few of these cities carry out the tests required in the specifications, their presence as a part of the contract makes it possible to draw the lines tight when necessary without ground for accusation of arbitrary action.

These requirements are presented, then,

VII. BRANCH BROOK PARK, NEWARK. SITE OF ARCHWAY UNDER DRIVE, 1897.

not as any indication of what course should be followed, but rather to show what variable results are obtained when specifications are prepared with little study of the material and the requirements that can legitimately be made. So long as dependence was placed on the uniformity of certain brands of cement of established reputation, the lack of rigid specifications, especially for Portland cement, was not so serious, but the vast expansion of cement manufacturing in the United States in the last three or four years and the large number of new brands make the preparation and enforcement of specifications a practical necessity, that the valuable cements may be secured and those which are carelessly or dishonestly prepared may be rejected.

The specifications should fit the work to be done and needless expense should not be added to the work by requiring an expensive cement of high test when a cheaper cement will answer every purpose; but in general it may be said that all the requirements can be materially increased without increasing the cost, the supply of good cement now being so great that the price will become lower until the limit of the saving from modern methods of manufacture is reached.

Comparison of Cost of Asphalt Pavements.

On another page will be found a table giving a comparison of the cost of asphalt pavements in the year 1900 in various cities, the figures being reduced to the conditions at Buffalo, New York, according to the judgment of City Engineer Bardol. His statement of the method of making the reduction, accompanying the table, gives the basis for the comparison.

From the table we present have been omitted such cities as gave insufficient data for determining the price for the last column. The average price actually paid by the cities given in the table is $2.28. Buffalo pays $2.20, or 8 cents less than the average. When the corrections have been made to reduce all to the same condition, that at Buffalo, the average becomes $2.41, and Buffalo pays 21 cents less than the average. That is, Buffalo pays for the same pavement 21 cents less than the average city is paying.

As to concrete, the average city pays about 12 to 15 cents more than Buffalo. This is due to the fact that many of the cities use more natural cement mortar in proportion to the stone, and to the further fact that quite a number use Portland cement. The cost of cement is less in Buffalo, also, than in any other cities, except Peoria, Milwaukee and Cincinnati, which are practically as near their supplies of cement as Buffalo to its supply. Broken stone costs less than the average in Buffalo, but sand costs somewhat more.

Binder and wearing surface both cost Buffalo more than they do other cities, so that the amount saved on concrete is made up on the top layers. This is because the thickness of binder is greater than in the majority of cities reporting, and there are more cities using a wearing surface less than two inches thick than one more than two inches thick.

Guaranty being for ten years in Buffalo and but 5 or 7 years in nearly half of the cities reporting, it is necessary to add 7 or 8 cents to bring the price up to that at Buffalo. Experience in repairing streets in Buffalo doubtless warrants the assumption that it costs but 3 cents to keep a yard of street in repair the first 5 years and 15 cents the second 5 years. If this assumption is correct it will pay all cities, upon the showing of this table, to increase the guaranty period to ten years, for almost all the difference between the average cost and the cost at Buffalo is found in this one item, the others nearly balancing themselves as stated. This means that Buffalo is getting a 10-year guaranty for less money than it would cost the cities to repair their pavements the second five years at the rates in the table.

The labor conditions on the average are not far different from those at Buffalo, what slight difference there is being in favor of Buffalo workmen.

The table and the explanation accompanying it will be valuable to city engineers for comparison with their own conditions, and a careful study of the various items will show in what lines improvements or reductions in cost can be made.

The Buffalo pavements are usually considered to be of the best quality and the wearing surface is certainly stronger than in most cities. This doubtless has its effect upon the maintenance charge, and the figures assumed for such charge may be too small on this account. This would increase the difference in favor of Buffalo. Whether this effect is sufficient to warrant an increase by other cities to the Buffalo specification for wearing surface is questionable. An increase of the guaranty period to ten years without the increase in thickness of surface layer may be more economical in the long run. It would apparently reduce the cost for the first ten years of the life of the pavement.

The names of the contractors laying the

VIII. BRANCH BROOK PARK, NEWARK. ARCHWAY UNDER DRIVE EAST OF LAKE, 1899.

pavements are omitted from our table for the reason that the amount and character of the competition does not seem to have any effect upon the average prices for 1900 which can be detected.

Defects in Brick Pavements Under Guaranty. A correspondent asks what defects in a brick pavement constitute a fair demand for repairs under a guaranty for a fixed period. It is probable that our readers have many varieties of opinion on this subject and some may be willing to express them. Early in the use of brick for paving the tendency was to require but little under the guaranty for a period of years beyond the prompt replacing of bricks found to be softer than their fellows and thus giving rise to depressions the size of the brick but rapidly increasing on account of the added wear upon the exposed edges of the adjoining bricks. As the art of burning paving brick developed, the proportion of such softer brick to pass the selection at the kiln and the inspector on the work decreased. Some makers were so sure of their material that they were willing to give a practical guaranty against wear for a reasonable time, say five years, and to point to the condition of the street at the end of the term as a proof of the indestructible character of their material. The character of the foundation is so essential a part of such a guaranty as this that it has probably been given but seldom, except when the pavement had a properly constructed concrete base, or the traffic on the street was exceedingly light.

For such foundations a guaranty of the whole pavement amounts simply to a guaranty of the wearing surface. But for cheaper foundations, unequal settlement, washing out of filling and even small amounts of subgrade or sand cushion, or the action of heavy loads in forcing sections of pavement down, all have their effect upon the wear of the brick, and the guaranty of the pavement is as much that of the foundation as of the wearing surface.

With so many variations of condition and so many chances for differences of opinion, it is impossible to set a definite rule which shall apply to all pavements. In one place the guaranty means the replacement of soft brick; in another it means practically a guaranty against wear, aside from edges of brick; in another it means a guaranty against settlement of the pavement; in others it means combinations of two or more of these demands; but usually it is an indefinite provision which is difficult to enforce unless the work or material turns out to be so poor that its defective character could have been observed during construction if there had been any inspection worthy of the name.

A few cities have fixed a schedule of repairs that can be demanded for asphalt pavements under guaranty and a similar schedule may be used for the most comprehensive guaranty described above. Settlements of foundation being practically eliminated by its solid character, unless on such a scale as to require reconstruction of the settled portion of the pavement, such guaranty against wear might require replacing of brick when the wear at any one spot brings it say ¼ or ½ inch below the surface surrounding and should certainly cover the prompt replacement of single bricks which are found to be soft enough to show greater wear than those adjoining. Such a guaranty as this can hardly be required of a pavement on a gravel or broken stone foundation, as settlements of such a foundation are apparently inevitable. The limit of variation from a uniform surface must be increased and the necessity of repair and the responsibility for it must be left more largely to the judgment of some expert upon the action of such pavements in use.

If any of our readers have any experience to report, or any suggestions regarding a schedule of repair requirements, we hope to hear from them, and will continue the consideration of the question in the light of such experience.

Should Rates Vary With the Use Made of Water? The statement is made that the rates for the use of water in Kaslo, B. C., are based, not on the estimated quantity of water used, but on the use made of the water, and it is desired, in preparation for introducing the meter system, to determine the proportion between meter and flat rates for each business listed on the rate card, that the new meter rates may agree as nearly as possible with the present flat rates, when a year's consumption is taken into account.

The usual principle used in fixing flat rates has been to estimate, with very slight approach to accuracy, to be sure, the amount of water to be used legitimately, though the ability of the business to pay for the water used has had some effect, doubtless, in fixing some of the rates. The lack of sufficient data upon which to base such estimates has tended to perpetuate some peculiar rate cards adopted many years ago, but there should now be, in the records of a number of water-works, data which, supplemented by a little effort in de-

termining the number of barrels of flour used in a bakery, the number of chairs in a barber shop, etc., would give the basis for the comparison desired.

But should the rates be different for different uses of water? It is usually considered that when large quantities of water are consumed there should be a wholesale rate, lower than that for ordinary family use, for example, but from the standpoint of the purveyor of water supply this is not defensible. It costs him quite as much to furnish one gallon of a million to one consumer as it does to furnish one gallon of a thousand to another, and when certain fixed minimum charges, to cover the individual expense of maintaining the connection, reading and recording meter, bookkeeping and collecting are made, he considers that any more water should be paid for at a fixed rate per gallon, no matter what the quantity consumed. If water is pumped, the justice of this is evident. If it is furnished by gravity, in quantities only limited by the capacity of the supply pipe, it is none the less true, though not so important a feature in the rate card.

The development of manufactures is one of the reasons given for the wholesale rate, and if this occurs, and the city as a whole is benefited, the water department or the water company may consider itself justified in its course, though, if meter rates are in force on all connections, it is a question whether the courts would sustain different rates for different customers, were the case properly brought before them. When this argument is carried as far as our correspondent carries it in the question stated in full in our Question Department, the principle involved is more clearly visible, and such discrimination in rates among ordinary commercial consumers as he suggests, is still more doubtful of approval by the legal tribunal.

ANSWERS TO QUESTIONS.

METHODS OF ASSESSMENTS FOR STREET IMPROVEMENTS.

We are about to pave several streets in this borough the coming summer, and will do so on the assessment plan.

The first street to be paved is Morris street, which will include all intersections of alleys and streets to the property line. Some of the cross streets will be paved also.

Would it be proper to assess to the property owners all intersections, or shall I charge them to the borough?

I have made assessments where single street has been paved, taking the total cost of said improvement and dividing this by the total frontage, which gives the pro rata per foot. It hardly looks fair to assess total cost including intersections, when a cross street would not be counted in. It seems to me the borough would have to stand the intersections, especially street. Also, what about the grading, what part goes to the borough, or do you include total cost to property owners?

Would be glad to hear from you, as you receive so much information on these questions.

Geo. D. Jenkins, Board Engineer,
Waynesburg, Pa.

If it were possible to determine exactly the benefit to each piece of property and to the city, the assessment of benefits would be the ideal method. It is quite impossible, however, to do this, and some approximation must be made. Some cities have a provision that not more than 25 per cent. of the value of the property can be assessed against it for any one improvement or in any one year. This is an error quite as often as it is a protection to cheap property. Thus an unimproved lot may prevent the improvement of a street, although the benefit to the lot is such as to make an unsalable lot into good property, while to the adjoining improved lot it gives only a small increase in value.

Frequently the street intersections are assessed against the municipal corporation on the principle that the pavement is a benefit to the city at large and that this is a convenient measure of that benefit. For well traveled thoroughfares this is probably near the truth, but for suburban streets it may often be more than the city's proportion of benefit.

In some cities the entire cost of the pavement, including intersections, is assessed against the property, usually on the principle that the benefits to the property are greater than the amounts assessed, and that the general benefit to the city at large is equalized in the end by the improvement of all the streets with the various grades of material required on the various classes of streets. The inability of the city to pay its share is a prime factor in arriving at this decision in nearly every case. If the scheme of improvements is broad and is proceeded with as rapidly as possible, this argument has much weight, but when a very few streets traveled by all citizens are to be improved, the residence streets being left in their present condition, the argument loses much of its force. There still remains, however, the fact that the assessment of cost is less than the amount of benefits, and the

claim by some theorists that the remainder should go to the benefit of the city at large. It is not usual, however, to claim more of this balance of benefits than enough to pay the city's share of the cost of the improvement.

The cross streets are benefited by the improvement of a street and should receive a part of the assessment of cost of intersections. In Indianapolis the entire cost of street is assessed on the abutting property and the cross streets for one block each side of the street improved, the cross streets receiving a less rate per front foot than the assessment on the street improved.

It is usual to assess the cost at a uniform rate per front foot as the nearest approximation to an equitable distribution. With a provision for revising the assessment on pieces of property under exceptional conditions, this is the most satisfactory method.

What modifications of these various methods shall be made must be determined by a study of the local conditions, selecting the method and its modifications so that the rule adopted shall make the assessments as nearly proportional to property and general benefits as possible, and shall have few, if any, exceptions.

If grading is heavy enough to be considered separately, it should receive special treatment. Often there must be an assessment of damages as well as of benefits. These may be considered together or separately. Separate boards of viewers for damages and benefits are frequently appointed, the resulting payment to or from the property owner being the difference between the two. Sometimes damages are awarded and the benefits are assessed uniformly per front foot to equal the cost of the improvement as for paving assessments. The argument in favor of including the street intersections in the frontage and assessing their proportion upon the city is stronger than in the case of paving assessments.

MACADAM FOR SMALL CITY.

Mr. H. M., of Connersville, Ind., asks (page 84, February number) for information as to cost, etc., of macadam for small cities. Of course prices and conditions differ in different locations, but the prices here are as follows: Grading, about 20 cents per cubic yard: plank curbing, 3x12, about ten cents per lineal foot, laid: basalt block curbing, (blocks about 10x10x5) about 12 cents per lineal foot; broken stone gutters, stone averaging about four to the square foot, and about 5 inches thick when laid, joints grouted (cement 1, sand 3) cost 7½ cents per square foot; macadam, 8 inches in depth at center and 6 inches at the sides, costs on average 4½ cents per square foot. The cost of the grading and macadamizing includes rolling the roadbed, also the macadam "until no farther settlement can be observed under the city's roller." (A horse roller weighs about 6 tons to a width of 60 inches.)

The population of Petaluma is 3,900. Our business streets are paved with basalt blocks. Residence streets that have been macadamized show but little if any wear in five or six years, notwithstanding they have never been intelligently and systematically cared for. One block that was macadamized two years ago takes all of the heavy hauling from the steamer landing and a good deal from the railroad depot without perceptible wear as yet.

N. S. Frost, City Engineer,
Petaluma, Cal.

ASPHALT BLOCKS.

What have you published in regard to asphalt blocks for street paving? Who manufactures them and the machinery for making them? Are they satisfactory?

Lone Star Asphalt Sidewalk Co.,
Dallas, Texas.

Articles and answers to questions which cover these points will be found in the following numbers of MUNICIPAL ENGINEERING: January, 1898, pp. 34 and 42; April, 1898, p. 210; August, 1898, p. 102; April, 1899, p. 259, and in this number the article on Asphalt Block Pavements in Pontiac, Mich. The makers of the blocks in this country are mentioned in these articles and our advertising columns. The blocks are made by patented process under license of the owners of the patents.

BOOKS ON STREET AND SEWER WORK.

I am an inspector of city improvement work and wish to read some books on the use of cement and on brick paving. Can you give me a list?

A. G. Wooster, Fremont, Wash.

A good hand-book for the inspector is Byrne's "Inspection of the Materials and Workmanship Employed in Construction" ($3). Mr. Byrne has also a good book on "Highway Construction" ($5), which treats of the construction of roads and of city streets with all the materials ordinarily used. On cement a practical book is Spalding's "Hydraulic Cement: its Properties, Testing and Use" ($2). Mr. Spalding also has a small but valuable book on "Roads and Pavements" ($2), covering about the same ground as Byrne, but less exhaustively. Baker's "Masonry Construction" ($5) has

very valuable chapters on cement and concrete. Johnson's "Materials of Construction" (86) considers in considerable detail the materials entering into the constructions mentioned, as well as all others in engineering structures. MUNICIPAL ENGINEERING can supply any books desired.

CONCRETE FOR BUILDING FOUNDATIONS.

Can you give us information in regard to the use of concrete for walls, foundations and piers of dwelling-houses? *Roland Park Company, Baltimore, Md.*

The forthcoming "Directory of American Cement Industries and Hand-Book for Cement Users" will contain much upon this subject. For foundations and piers for dwelling-houses, an extra quality of natural hydraulic cement concrete, or one of the cheaper mixtures of Portland cement concrete, will be satisfactory. Box forms must be used where the soil does not confine the concrete. For walls, it is probable that some form of expanded metal construction, as put up by contractors in these materials, will be more satisfactory and cheaper than walls of the thickness necessary if made of concrete alone.

CEMENT FOR STEPS.

We wish to know something of the relative value of stone and cement for use in the steps at the front of a handsome new church we are building. *H. M. Grigsby, Pulaski, Tenn.*

While some kinds of stone are very handsome and durable when used for such a purpose, it is possible to construct steps of cement concrete which shall be as handsome as those of any stone ordinarily used for this purpose, and at a less cost, unless suitable stone is found in the immediate neighborhood. The method of making mixture and of constructing the steps does not differ in principle from that used in making cement walks and curb.

EXAMINATIONS OF CITY ENGINEERS.

Is there a system of examinations of candidates for appointment to positions as city engineer in England, or any eligible list from which such appointments can be made? Does the Institution of Civil Engineers conduct such examinations? *J. R. C., Syracuse, N. Y.*

An editorial on "Certificates of Professional Standing," on page 352 of the number of this magazine for June, 1898, gives some statement of the condition of affairs in England. The Institution of Civil Engineers now conducts examinations for determining the theoretical qualifications of applicants for membership in that body. Membership in the Institution does not, however, carry any more weight in determining the question of eligibility to municipal office than membership in the American Society of Civil Engineers does in the United States. Both societies have some members, admitted years ago, who would not be eligible under the present high standards of qualification set. Membership in either society secured since the adoption of the present standard is evidence of more than average ability as an engineer.

There is in England an Association of Municipal and County Engineers which is trying to create a public sentiment in favor of special qualifications for public engineering service. One of its methods, as explained in the editorial referred to, is by the creation of an eligible list for such appointments. This list is made up from those who pass examinations set by the association. These examinations are open to all applicants whether members of the association or not. The character of the examinations is such that the presence of a man's name on the association's eligible list is evidence of his ability to conduct successfully the operations under the control of the city or borough engineer or surveyor, whatever the name of the office may be. There is no assurance, however, that a municipality will select its officer from this list. The matter is entirely voluntary and is not yet established in public opinion in the position it deserves.

Some municipalities conduct their own examinations of candidates, but even then are not bound to select the most competent, and as a matter of fact often do not.

Practically the question of qualifications of city engineers is in the same condition as in this country, though the eligible list of the association is a ray of light which may increase in brilliancy as its value secures recognition.

VITRIFIED PIPE FOR WATER CONDUIT.

In the matter of vitrified pipe for water conduits in your February number, is it the intention to carry water under a head at any time, and can you give me any data as to what would be a safe pressure upon pipes and joints of a similar nature? *R. W. Farley, City Engineer, Hull, P. Q.*

On page 90 of the article referred to, it will be noted that at one point the Hartford 24-inch pipe conduit was carried below the hydraulic grade line for a distance of 300 feet, being under a head of 9.65 feet at the lowest point of this depression in the line. This would put the pipe under a pressure of about 4 pounds to the square inch. Three lengths of iron pipe were used at the lowest point, not on account of the head, but that

they might be supported on concrete piers at the stream crossing and thus cheaply prevent settlement. With this exception, it is probably not intended to carry the vitrified pipe under head. There are so many more unknown quantities, in uniformity of material, in strength of joints, in effect of water hammer, and in greater damage from settlements, that a factor of safety for a vitrified pipe is hard to fix; and so, while it is probable that many such lines, as laid, could carry much more than 5 pounds steady pressure, it is seldom that this amount is exceeded.

RELATION OF METER AND FLAT RATES.

Our rates for furnishing water are the ordinary flat rates, and are not based on the amount of water used, but on the use made of the water, so that if meters were introduced, the meter rate per gallon would be different for each business. We wish to introduce meters, to stop the unnecessary waste of water, and would like to make the rates for legitimate use under the meter system as nearly as possible the same as the present flat rates, if we can get any information upon the amount of water, maximum, minimum, or average, used in each business. Included in the list are, bakeries, per barrel of flour; barber-shops, each chair; bath tubs, each tub in hotels, boarding-houses, barber-shops and bathing-houses; blacksmith-shops, each fire; bookbinders, each person; brewers, etc., in the same detail, through the alphabet. Have you any information which will be of assistance to us?

D. P. Kaul, Water Commissioner,
Kasto, B. C.

When the meter system is adopted it is not usual to make the comparisons between the old and the new rates in the form desired, but possibly some of our subscribers have data which they will be willing to put in form. While we may not agree with the statement that the meter rates should be different for different kinds of business, the comparison desired will be of interest, and we will publish anything of value which our correspondents may send in. Some comment on this subject is made by the Editorial Department.

DISCOLORATION OF PLASTERING.

In reply to the inquiry of Chas. Baillairge, C. E., Quebec, for reason of battens or lath showing through ceiling or plastering I submit the following: By reason of the difference in conductivity the spaces between lath are at a lower temperature than the surfaces under the lath, hence the moisture in the air is condensed and smoke and dust absorbed in a larger amount between the lath than under them. From a table of conducting power of different substances I conclude plastering is 32—wood 4. Then if the section through the lath is one-half wood the relative convection of plastering to lath section would be 4 to 1. Hence the space between the lath would be four shades blacker than the surface backed by lath. As a remedy I would suggest a backing of mineral wool or back plastering rich in plaster of paris and wood ashes.

Holland Wheeler, C. E.,
Lawrence, Kan.

EGG-SHAPED SEWERS.

I would like a book on the design of egg-shaped sewers, and containing tables of their capacity.

J. Ross Robertson, C. E., Keokuk, Iowa.

Folwell's "Sewerage" ($3) gives the principles of the design and construction of egg-shaped sewers and comparisons with circular sewers, all in considerable detail, but does not seem to give tables of flow, although he gives them for circular sewers. Ogden's "Sewer Design" ($2) gives less upon the detail of design and construction but gives a diagram, on a small scale, of discharge and velocity in egg-shapped sewers on various gradients. The best piece of apparatus for the determination of the elements of both circular and egg-shaped sewers is Colby's "Sewer Computer" ($10), being more convenient than most diagrams and absolutely correct, according to Kutter's formula.

CENTRAL STATION STEAM HEATING PLANT.

To the list of central station steam heating plants given in this department in December, 1900, may be added the plant of the Springfield Electric Light and Power Company of Springfield, Ill., A. V. Schroder, superintendent, which uses the Holly or American District Steam Heating Company's system, carries a steam pressure of 4½ to 5 pounds, extends its pipes a half mile from the station, heats about 7,000,000 cubic feet of space, and charges 25 cents a square foot a year for direct radiating surface.

ELECTRIC TRANSMISSION OF POWER IN CEMENT MANUFACTURING PLANTS.

Can you give us the name and location of cement works who have adopted electrical drives for their machinery?

The New England Engineering Co.,
New York City.

The Whitehall Portland Cement Company, of Cementon, Pa., and the Portland Cement Co. of Utah, of Salt Lake City, have installed full systems of electric transmission of power. Others which use electricity to some extent in the operation of their works, aside from lighting, are the California Portland Cement Company, Colton, Cal.; the Iola Portland Cement Com-

pany, Iola, Kan.; the William Krause & Sons Cement Company, Martin's Creek, Pa.; the Lawrence Cement Company, of Pennsylvania, at Siegfried, Pa. Some of the works under construction will also use electric transmission, and some of the older works have the system under consideration.

The Alpha Portland Cement Co., of Easton, Pa., will soon install a plant in its works. Consult the forthcoming "Directory of American Cement Industries and Hand-Book for Cement Industries" to be issued soon by Municipal Engineering Company.

STAND PIPES AND ELEVATED RESERVOIRS.*

By George S. Pierson, Mem. Soc. C. E., Kalamazoo, Mich.

It has long been customary to store water at an elevation which will distribute it under pressure for domestic use.

Standpipes and elevated reservoirs on any extended scale are a comparatively late development and are due to improved processes and increased skill in the manufacture and manipulation of iron. Iron is a material particularly well adapted to resist the tensile strains in a tank in which water is confined and is also the cheapest of metals.

Modern progress along this line of construction has made it possible for cities located on comparatively level sites to avail themselves of all the advantages of water pressure due to gravity.

Standpipes and elevated reservoirs are useful in the following ways: They afford much safer fire protection than any means of pumping directly into the water mains. Whatever water may be stored in them may be counted upon with certainty to exercise its maximum possible effort beyond the possibility of interference by the failure of moving mechanical parts, inattention of attendants, etc.

A comparatively insufficient water supply may serve well a much larger city than it possibly could if pumped directly into the water mains.

An important economy in fuel consumption of the pumps is possible where water can be pumped into storage and the pumps during that operation can be run at an economical capacity. In a general way it may be stated that steam pumps when run at one-tenth of their capacity consume about four times the amount of fuel per million gallons as when run at their economical speed. When run at one-fourth their capacity about twice as much, and at one-half their capacity about one and two-thirds times as much.

As a practical illustration, a duplex pump in actual service used an average of 20,000 pounds of coal for each 1,000,000 gallons of water pumped 100 feet high during the year, the average rate of pumping being about one-tenth the capacity of the engine.

If the engine had been run at its economical capacity it should, while running, have used not more than 4,000 pounds of coal in performing the same amount of work, which corresponds to a duty of only 21,000,000. An examination of the performance of gas and gasoline engines under various proportions of load, indicated approximately the relative efficiency.

A 10-horse power Otto engine, under favorable conditions, consumed about the following amounts of gasoline for various loads:

No load (friction of engine).	.11	Gals.	per	hour	per	H. P.
1-6 load	.27	"	"	"	"	"
¼ "	.25	"	"	"	"	"
½ "	.15	"	"	"	"	"
¾ "	.14	"	"	"	"	"
Full "	.12	"	"	"	"	"

From the above table it will be seen that the greatest economy is at full load, and that below ½ load the economy decreases rapidly, more than twice the amount of fuel being required per horse power below ¼ load than at full load.

In steam plants operated in connection with water towers some fuel would be consumed in banking fires, etc. In gasoline plants no fuel would be consumed, except when the pumps were actually in service, and the same would apply to electrically transmitted power paid for by meter measurement. The utility of an elevated reservoir under these conditions is apparent.

In order that the full economy of water towers may be secured in small plants, they should be elevated to a hight which will give fire protection, otherwise the pumping machinery must be always in service, or ready for service, and the full economy in fuel consumption cannot be secured. Low tanks, however, may have an important effect in adding to an insufficient water supply.

It requires more fuel to pump water into a reservoir elevated sufficiently for fire protection than to pump against a lower pressure, but not as much in proportion to the head pumped against, and in any but the larger plants this is more than balanced by the increased economy due to the pumps running at an economical load. In order to arrive at the proper hight of elevated reservoirs a consideration of the requirements of fire and domestic service and of the influence of hose lines, etc., upon the pressure is necessary. Tables are published giv-

*A paper read before the Michigan Engineering Society.

ing the pressure per square inch required at the hydrant to furnish fire streams of various sizes through hose lines of various lengths. A fair stream such as would be useful in the case of a small detached building, from a ¾-inch nozzle at the end of 100 feet of hose, can be secured with a hydrant pressure of 32 pounds. The same stream, delivered through 300 feet of hose, requires 36 pounds pressure at the hydrant, and through 500 feet of hose, 40 pounds at the hydrant.

It is apparent that a pressure of less than thirty-two pounds at the hydrant, which corresponds to a hight of about seventy-five feet, is of little service as a protection against fire. A pressure of seventy-five or eighty pounds at the hydrant is desirable, and this corresponds to a hight of about 180 feet, not considering the friction in mains. This will supply a one-inch stream discharging 198 gallons per minute through 300 feet of hose, and may be considered a good fire stream. It is desirable to have a pressure, for domestic service, of from thirty to thirty-five pounds at least, and this corresponds to the minimum pressure we have allowed for fire pressure.

The writer does not mean to say that a less pressure than is here mentioned is of no value, but it is extremely desirable to maintain a pressure above the minimum which has been specified.

This brings us to the consideration of the kind of structure best adapted to store water at the desired elevation. If a convenient elevation of ground is close at hand, seventy-five feet or more above the level of the city, the problem is a very simple one, and a plain tank set with its bottom at this elevation will accomplish the desired result. If the city is located upon level ground and no elevation is within reasonable distance the problem is not so simple.

Standpipes have been used quite generally under both of the above conditions. Lately, however, tanks elevated upon trestle towers are often being used under the second condition. The relative advantages and disadvantages of the two types where water must be held in storage at a considerable elevation above the ground level are as follows:

In order to store a sufficient volume within the desired limits of minimum and maximum elevation, it is necessary to proportion the diameter of the tank according to the amount of storage desired. If the standpipe form of construction be used this diameter must be continued to the ground. If an elevated tank is used, the structure upholding it may be proportioned simply to meet the strains which come upon it, which are much less than those which come upon a standpipe holding the same amount of water at the same hight, since the effect of wind upon the trestle tower is much less than upon the elevated tank and hydrostatic pressure below the bottom of the tank is exerted on a much smaller area. Much less iron is therefore required in the lower part of the structure than is required in the standpipe below the same elevation.

The relative advantages of the two methods of construction are therefore dependent upon the hight above the ground level at which it is desired to store the water.

The Chicago Bridge and Iron company have kindly sent me some estimates of the cost of structures of both kinds from which I have compiled the following comparative estimates of cost of standpipes and elevated tanks storing certain amounts of water at an elevation of seventy-five feet or more above the ground level.

The comparative cost of standpipe and elevated tank in each case is represented by percentages, and the elevation of the center of gravity of the stored water is also given and it will be noticed that in all cases the elevation of the water stored is greatest in the elevated tank, and that the cost of the tank is less than the cost of the standpipe.

10x100 standpipe, 100 per cent., 87.5 ft. to center of gravity.

15,000-gallon tank, 72.5 per cent., 91 ft. to center of gravity.

12x120 standpipe, 100 per cent., 97 ft. to center of gravity.

40,000-gallon tank, 85 per cent., 108 ft. to center of gravity.

14x140 standpipe, 100 per cent., 107.5 ft. to center of gravity.

75,000-gallon tank, 78 per cent., 124 ft. to center of gravity.

16x150 standpipe, 100 per cent., 112.5 ft to center of gravity.

115,000-gallon tank, 77 per cent., 133 ft. to center of gravity.

18x150 standpipe, 100 per cent., 112.5 ft. to center of gravity.

140,000-gallon tank, 89 per cent., 131 ft. to center of gravity.

20x150 standpipe, 100 per cent., 112.5 ft. to center of gravity.

175,000-gallon tank, 68 per cent., 125 ft. to center of gravity.

The cost of foundations is included.

This indicates clearly the relative cost of the two classes of structure for storing the stated amounts of water at the elevation given. There is, however, another objection to high standpipes. A certain relation of diameter to hight should be maintained in order to secure stability, and this requires the use of such heavy plates in the lower courses as to make this form of construction undesirable, as I shall show later in this article.

In certain locations it may be advisable to support a tank upon a masonry column in preference to an iron trestle tower.

When the tank is to be inclosed the masonry offers a convenient support for the inclosing shell and roof.

Tanks for the storage of waters should be roofed. They should be entirely clear of any inside ladders or similar construction to which ice might adhere.

ELEVATED TANK AT PAW PAW, MICHIGAN.

Probably no kind of engineering structure presents such a lamentable history of failures in comparison with the number of structures built as do standpipes. There have been as many as six failures of standpipes during one year in the United States out of a total number in service of probably less than one thousand.

It may be interesting, especially at a meeting of engineers, to look into the theories upon which these structures have been designed, and to consider the conditions under which some of them have failed and to outline what may be a reasonable provision against the stresses to which they may be subjected.

In the Engineering News of May 24, 1894, is a classified record of the failure of twenty-eight standpipes. Of these, six

failed while being tested, and in five of these the failure was due to insufficient strength in the side plates. Of the total number of failures, eighteen failures out of the twenty-eight were due to the failure of the side plates; two were due to the collapse of the upper plates during storms from the wind pressure; three were due to insufficient anchorage, and three were due to failures in the foundation. In seventeen cases out of the twenty-eight the failures were total. Three failures occurred during a cyclone or hurricane, three during storms and in eight cases there was ice in the tank.

It will be observed that in many cases failures occurred when the standpipes were subjected to no extraordinary strain and under conditions of service to which they might be subjected every day during the year, and of such it can be said with certainty that they were improperly designed or the construction was faulty. And it is equally certain that many that have not yet failed are subject to the same criticism.

Recent practice seems to favor the use of steel for water tower construction.

The strains which ordinarily come upon a standpipe or elevated tank are those due to the pressure of water within and to the wind.

Extraordinary strains may also come upon a tank. The ones most to be feared are those due to ice. These strains can hardly be computed and may be much greater than any reasonable construction can resist. Ice may form upon the surface of the water in the tank or in the form of a tube around the inside of the tank. It may thus subject the metal to enormous strains. Or, at times when the water is low in the standpipe and warm weather succeeds a period of extreme cold, large masses of ice may become detached from the sides of the tank and fall, creating excessive strains by their impact.

Evidently it is impractical to build structures of iron or steel capable of withstanding the maximum strains to which they might be subjected from this source, and therefore the proper care of such structures when in service is no less important than is their correct design. All that is necessary is to keep the structure reasonably free from ice. This is not a difficult matter in the coldest weather, especially with ground water supplies. All that is necessary in any case is to increase the circulation as may be required for a short period during extreme cold.

If the tank is inclosed, probably no precautions of this kind will be necessary. Inclosed water towers may be made very attractive in appearance and it is in every way desirable to have them inclosed. It adds greatly to the cost, however, and we in the West usually spread a dollar over too many acres. An uninclosed structure may be made quite attractive in appearance at the expense of a little thought. Uninclosed tanks are in successful service nearly as far north as Hudson bay.

The strains which may come upon a tank from its contained water and from wind pressure are readily computed. The strains due to hydrostatic pressure act always in the same way. That is to say, they never alternate in direction. I find a wide difference in the methods by which the strains in the horizontal seams are determined and a corresponding disparity in the strength of seams recommended by various engineers who have proposed formulas for its determination amounting to a variation from lowest to highest of about ten-fold (1,000 per cent.).

The strains upon the horizontal seams of standpipes are due to the weight of metal above the joint and to wind pressure.

The maximum wind strain per lineal inch upon any horizontal joint in a standpipe is equal to the square of the hight above the joint multiplied by the wind pressure per square foot, divided by 37.5 times the diameter.

The value of wind pressure is to be taken at its full value upon a flat surface equal to the diameter of the stand pipe multiplied by the hight above the joint.

In the development of the formula this is reduced one-half, as is customary for cylindrical surfaces.

This, however, gives simply the strain which may come upon the joints during a wind of constant intensity.

The direction of the wind strains alternates as the direction of the wind is reversed; and what is more important to consider, they may alternate rapidly if the wind is gusty and the tank is high in proportion to its diameter so that there is a tendency for it to weave back and forth. Thus excessive strains may be brought to bear upon the horizontal joints and they may fail, as a small boy breaks down a tree by repeatedly pushing it at the proper instant so as to make it weave from side to side. The strains which might come upon the horizontal seams in such a case as this cannot readily be computed, but a reasonable allowance should be made for them. Guys are sometimes recommended for standpipes which are tall in proportion to their diameter. I doubt their utility, however, as it seems difficult to arrange them so as to entirely prevent the weaving of a tall pipe, and if this occurs, the seams must be materially weakened.

Probably the best arrangement of guys would be an arrangement similar to the arrangement of tangent spokes in a modern bicycle wheel in which the guys would be attached to an iron angle surrounding the pipe and would be directly opposed to one

another and could then be strained to any desired degree without deforming the tank.

Slack guys can have but little effect in preventing the alternation of stresses in the horizontal joints.

In this connection it may be interesting to note that riveted joints slip visibly under a small strain. Experiments have shown in a general way that this may occur at about one-tenth the breaking strain and that hand riveted joints will slip at about half the load required to produce the same effect in machine riveted joints. This indicates that hand riveted joints, particularly, may deteriorate under alternating stress.

The best form of construction seems to be that in which the tank is self-supporting and this favors the elevated tank in preference to the standpipe where water must be stored at any considerable hight above the ground. The strains which come upon a supporting trestle are computed as in bridge work and will not be discussed here.

The most economical form of construction for the elevated tower is that in which the tank has a hanging bottom. This may be accomplished by either a conical bottom or a bottom approaching a spherical form. The latter form occasions less lateral thrust where it is connected with the side plates and requires less strength in the circular girder to offset the thrust. I believe that this form can also be constructed, if properly designed, with less deformation of the plate where it is connected with the side plates than can the conical bottom.

The photograph upon another page shows an elevated tank of this kind which was erected by the Chicago Bridge and Iron company, under the direction of the writer, at Paw Paw, Mich.

The illustration also shows the advantages of design which this kind of structure offers in resisting wind strains. It will be noticed that the base of the trestle can be spread so as to offer more resistance to overturning without materially increasing the amount of metal, the horizontal struts and lateral rods being comparatively light. In this tower the diameter of the trunk is but nineteen feet, and the spread of the base is thirty-six feet.

Water tanks are essentially riveted structures. The number of rivets which enter into the construction of a standpipe is appalling.

A properly proportioned riveted joint, theoretically, is one in which the rivets are equally liable to shear off or to be stripped through the plate, and in which the net section of the plate area has a strength equal to the shearing and bearing value of the rivets. Practically, however, in ordinary construction, and especially in hand riveting in the field, it is wise to depart from the proportions indicated by theory. Theoretical considerations indicate that the diameter of the rivet should be about two and a half times the thickness of the plate. The theoretical maximum possible efficiency of riveted joints is about as follows:

Single riveted .....60 per cent.
Double riveted .....75 per cent.
Triple riveted .....81 per cent.

This efficiency can only be secured, however, by the use of rivets having a diameter about two and a half times the thickness of the plate. In thick plates this would require a diameter of rivet which cannot be well manipulated in hand riveting. It is customary, therefore, to use rivets in thick plates smaller than indicated by the above proportion.

Considering the difficulties of manipulating large rivets by hand the use of comparatively small rivets in thick plates is entirely defensible. It must not be forgotten, however, that the efficiency of the joints, the same number of rows of rivets being used, will be much below the theoretical efficiency above given. For instance, if the diameter of the rivet is equal to the thickness of the plate no greater efficiency can be had than about as follows:

Single-riveted lap joints.....34 per cent.
Double-riveted lap joints .....51 per cent.
Triple-riveted lap joints .....61 per cent.

Butt joints, double cover straps—
Single-riveted .....51 per cent.
Double-riveted .....68 per cent.
Triple-riveted .....76 per cent.

This important point seems to have been often overlooked, and a misconception of the strength of joints which are made by using small rivets in thick plates seems to have led, in many designs, to a misunderstanding of the factor of safety which was really provided. Further than this it seems to have led to designs requiring more metal than necessary to secure the required strength and which at the same time are too weak for the strains which come upon them. For instance, a tank 40 feet in diameter and 120 feet high, designed with a bottom course of 1 9-32-inch steel plate of 60,000 pounds ultimate strength, joined with three rows of 1¼-inch rivets, is said to have a factor of safety of 6. No such factor is possible under the circumstances. The strain per lineal inch is about 13,000 pounds, and the ultimate strength of the entire plate (no allowance being made for rivet holes) is but 77,000 pounds, which corresponds with the factor of safety of 6 if the joints had the full strength of the plate. The writer knows of no scheme of riveting which will secure an efficiency at the joints of more than 100 per cent. of the plate. Under the conditions stated, if the joints were lapped joints, no greater efficiency than 63 per cent. could be secured, and the factor of safety would be about 3¾. If triple riveted butt joints with double cover straps had been used, no greater factor of safety could have been secured than about 4⅛.

Prof. Pence says: "It is quite generally believed that seven-eighths of an inch or one inch is the maximum thickness of plate which can be satisfactorily riveted by hand in the field, and such a limit should be observed in standpipe designs." Surely if this limit is observed, and a reasonable factor of safety is provided, the standpipe form of construction is not suited to the storage of any great amount of water at any great elevation above the ground. The limits of size which will be set by this thickness of plate and the amount of water which can be stored above any point can readily be determined.

Many careful experiments upon riveted joints have been made, but in many cases erroneous conclusions have been drawn from them. For instance, it has been shown that when holes are punched in narrow strips of steel plate the ultimate strength per square inch of the remaining metal was reduced about 10 per cent. and from this the conclusion has been drawn that the same thing occurs when holes are punched along the edge of a wide plate, as in boiler and standpipe riveting. This result does not necessarily follow. Other experiments on wide steel plates in which a number of holes were punched along the edge, as in standpipe work, have shown that the ultimate strength of the metal between the holes was increased about 20 per cent. for a pitch of 1.9 diameter, 15 per cent. for a pitch of 2 diameters and 10 degrees with a pitch of 3.6 diameters in plates as thick as three-quarters of an inch. It seems entirely reasonable that this should be so in soft steel plate. Undoubtedly in hard steel plates it would not be so. It is conceded that thick plates should be drilled.

Many interesting experiments have also been made as to the effect upon the strength of rivets of various proportions of diameter of rivet to diameter of rivet hole, but a discussion of these would take us too far from our subject.

It may be assumed in a general way that the plate work, which is done at the shop with convenient appliances at hand and under constant supervision, will be more perfectly done than the riveting which is done in the field, in awkward situations, often in inclement weather, with none but the simplest appliances at hand, and not usually under a very rigid inspection.

The writer reasons that the thicker plates are used in the larger structures, that the failure of the larger structures is attended with greater danger than the failure of smaller ones, and that thick plates and large rivets can hardly be worked with the same prospect of securing maximum theoretical strength as can thinner plates and smaller rivets.

There are many important points concerning the design of standpipes and elevated reservoirs that I have not touched upon and that cannot well be considered in a brief article, such as details of construction, anchorage, foundations, corrosion, electrolysis, stiffness in the upper plates to resist collapse from wind pressure, etc., etc.

Perhaps the one of most importance is the last mentioned, since the upper portion of the tanks must be empty most of the time. The record compiled by Prof. Pence shows that in five out of six failures due to wind the upper plates collapsed.

Evidently there is still room for improvement in the design of metal structures for the storage of water.

THE BLOCK ASPHALT PAVEMENTS OF PONTIAC, MICH.*

By William J. Fisher, Engineer, Pontiac, Mich.

A modern pavement that has been in use for a number of years in Washington; New Castle, Pa.; Ft. Wayne and Lafayette, Ind.; Dayton, Hamilton and Youngstown, O.; and for the past year in Pontiac, Muskegon, Grand Rapids and Detroit, Mich., and one that is now being introduced extensively elsewhere is known by the name of asphalt block in contradistinction from sheet asphalt pavements.

In 1899 Saginaw-st. was paved with asphalt block with a total of 26,885 yards, and E. Lawrence-st., 1,335 yards.

In 1900 N. Saginaw-st., 4,267 yards; Clark-st., 2,700 yards; W. Lawrence-st., 2,122 yards; Oakland-ave., 8,003 yards were paved.

The manufacture of asphalt paving block was first taken up in San Francisco in the year 1869 with very crude appliances for making the same.

In the manufacture of asphalt blocks the ingredients are crushed trap rock, limestone or copper ore tailings (the latter material being used in the Lake Erie asphalt block plant at Toledo, O.), and paving cement in the proportions of 85 to 90 per cent. of crushed stone or copper ore tailings and 10 to 15 per cent. of paving cement. The paving cement is made from steam refined Trinidad pitch lake asphalt and heavy petroleum in the proportion of 85 to 90 per cent. of asphalt and 10 to 15 per cent. of heavy petroleum. In the manufacture of asphalt block, if copper ore tailings are the chief ingredient, it is made use of in the same condition as it comes from the mills. If

* From a paper before the Michigan Engineering Society.

limestone is used it is first crushed, and then rolled and screened until partly pulverized. This material is then heated to a high degree of temperature, mixed with asphaltic paving cement and finally subjected in this heated state to a pressure of approximately 120 tons, equivalent to a 5,000-pound pressure per square inch, molded into a solid, homogeneous block and finally cooled under water. The processes of mixing, heating, compressing and cooling are under perfect control through the medium of modern machinery and appliances and the completed product is ready for immediate shipment.

Asphalt blocks are manufactured in different sizes from 4 in.x12 in. to 5 in.x12 in., and in thickness from 2 to 4 in. The weight of the block is from 12 to 22 lbs.

Gravel 6 in. in depth, compressed with a roller seven (7) tons in weight, and 1½ in. of clean sharp sand spread on top of the gravel, when placed upon a firm sub-grade, furnishes a trustworthy base for an asphalt block pavement.

The following are specifications prepared by the writer and adopted by the common council of the city of Pontiac, Michigan:

The roadway for its entire width is to be graded to such a depth that, when properly shaped and rolled to the satisfaction of the city engineer, it shall be at all points not less than 11½ in. below the surface of the pavement, except that portion occupied by the street car tracks, which shall be 15 in. below. All soft and spongy places not affording a firm foundation will be dug out and refilled with gravel and well rammed. The entire roadbed will be thoroughly rolled with a roller weighing not less than seven (7) tons, to the satisfaction of the engineer.

On top of the sub-grade prepared as above shall be spread a layer of good, clean gravel six (6) inches thick, after being rolled as above specified; one and one-half (1½) inches of clean sharp sand shall then be spread upon the gravel to serve as a cushion for the asphalt block, the surface of which shall conform to the surface of the finished pavement.

The size of the asphalt block will be 4x4x 12 ins., and a variation of one-fourth of an inch from these dimensions will be sufficient grounds for rejecting any block.

The blocks shall be laid at right angles to the line of the street with such crown as the engineer in charge may designate, each course to be laid so that all longitudinal joints shall be broken by a lap of at least four inches.

Each four courses of blocks shall be driven against the preceding course by a heavy maul, in order to make the lateral joints as tight as possible, and the longitudinal joints will be closed by pressing each course in the direction of its length by a lever or jack.

The blocks will then be rammed in a proper manner by a heavy rammer, or rolled with a roller not less than six tons in weight, until they form an evenly curved surface, smooth and unyielding, and finally covered with fine sharp sand, entirely free from loam; the sand to be swept into the joints until the same are filled, and allowed to remain on the streets for thirty (30) days, when it will be removed by the contractors.

Any blocks that disintegrate or wear more than ordinary within five years after the completion of the work will be renewed by the contractor without cost to the city.

The material and workmanship will be guaranteed in an amount equal to 50 per cent. of the total cost five years from and after the date of final estimate of the improvement by the city. The improvement shall be guaranteed to sustain without loss or injury, during the time of such guaranty, the ordinary traffic to which the public streets of the city of Pontiac are subjected.

Among the important features in connection with asphalt block pavement may be mentioned:

1. Its durability and lasting qualities.
2. Ease with which repairs can be made. The repairing outfit in connection with an asphalt block pavement consists simply of a pair of tongs, chisel, hammer and tamper.
3. Asphalt block is not affected by differences of temperature.
4. Asphalt block is sanitary.
5. Asphalt block pavement is smooth without being slippery. When the blocks are first laid there is somewhat of an uneveness on the surface of the pavement, which, however, disappears under the action of traffic.
6. Asphalt block pavement is comparatively noiseless, giving forth but little sound under the rolling of wheels.
7. Asphalt block pavement compares very favorably in cost with other pavements of as high a standard, the material costing approximately $1.90 per yard on board cars at Pontiac.

The finished pavement, including excavation, foundation, curbing, drain tile and all labor, etc., complete, costs $2.40 per sq. yd. This price will vary of course with width of pavement.

No repairs have been made upon our pavements since they have been laid; while their uniformity of appearance; smoothness, without being slippery; cleanliness and high degrees of sanitation, are all elements which contribute to the praise and esteem in which our asphalt block pavements are held.

EAST HARTFORD SEWER SYSTEM.*

By C. H. Olmstead, Engineer.

The central portion of the town of East Hartford, having grown in population to the point where the necessity of better sanitary condition was apparent to all, decided to build a system of sewers. At first public opinion seemed to be decidedly in favor of the "combined system," probably on account of the extreme flatness of the country and large amount of ground water. After a careful consideration of the recommendations and reports of the engineers the district decided to build what is known as "the separate system" of sanitary sewers.

Plans and estimates were made and adopted and bids advertised for. The contract was let to the lowest bidder; work was started July 10, 1900, and completed Jan. 3, 1901, or in a little less than six months. The system as completed comprises about nine miles of sanitary sewers of salt-glazed terra cotta pipe, including main and lateral sewers, ranging from twenty-four inches to eight inches in diameter, with an outlet about six thousand feet long of thirty-inch terra-cotta pipe; eighty-five manholes and eight flush tanks of the Miller six-inch siphon pattern. The siphons have a tank diameter of four and a half feet, with a discharging depth of thirty-two inches and with a discharging capacity of forty-one cubic feet. Manholes were built at all street intersections, or about five hundred feet apart where the distance was greater between intersecting streets. The comparatively small number of flush tanks is accounted for by the fact that there are a number of short laterals to be constructed in the near future that will be equipped with flush tanks.

The depth of excavation ranged from five feet to eighteen feet and was entirely in sand or clay, no rock being encountered throughout the work. Quicksand was often in evidence, but was not as hard to handle as most strata of sand of this order. Tight-sheeting, the use of clay or sod, and in a few places concrete, combined with patience, were able to secure good work.

Of the nine miles of pipe in the present system, eighteen thousand feet are laid between eight and ten feet below the surface, and 13,700 feet beteen 10 and 12 feet below the surface. The main or outfall sewer is built of terra-cotta pipe 30 inches in diameter; is 6,045 feet long and has a capacity of 4,200,000 gallons daily, sufficient to sewer a population of 55,000 people on a basis of 75 gallons per capita per day. Much water was encountered throughout the district. In many places water was found within 6 feet of the surface of the ground. From 1 to 3 diaphragm pumps, manned by from 2 to 4 men each, were in use with every gang of men, and although no steam pump was used at any time on the work there were places where a steam pump would have been of decided advantage. On account of the large amount of ground water and running sand, tight joints were difficult to make, but by the use of a hemp gasket, cement and protecting the cement by clay or sod, fairly tight work was secured as is shown by the comparatively small amount of leakage. This leakage of ground water amounts to 1¾ inches in depth at the terminal of the outlet sewer. In the laying of pipe, cement was placed on the bell, hemp gasket soaked in cement water placed on top of the cement, the ends of the gasket lying at the sides of the trench, a pipe inserted on the top of the gasket, a blow of the foot on the pipe to bring it into place, ends of the gaskef brought over the top of the pipe and twisted, joint thoroughly filled with cement, and clay or sod used to cover the cement and hold it in place until it has time to set.

In laying the 30-inch pipe, a ditch derrick with a winch was used. These pipes are 2½ feet long, 2¼ inches in thickness; depth of socket 3½ inches, and weight about 675 pounds per foot. Joints were made much the same as with small pipe except that the joints from the inside of the pipe were filled with neat cement. All manholes are either 4 feet circular or 3x5 elliptical, and have 8 inch walls and are plastered outside from top to bottom with cement and painted inside with cement wash. Whenever possible, channel pipe was used for inverts.

American Portland cement in a mixture of one part by measure of cement to two parts of sand was used on all brick and stone masonry and in the laying of all sizes of pipe, except the thirty-inch.

The contract price will amount to about $59,500. Extra work or work not provided for in the contract amounts to about $500.

This system as outlined, empties into the Hockanum river a little less than a quarter of a mile from the point where the Hockanum meets the Connecticut river.

Realizing that the time is not far distant when this state, and I trust all states, will take some legislative action prohibiting the pollution of our streams and rivers by emptying into them the garbage and sewage from cities and towns, this sewerage system was so planned that we could for the present help to increase the nuisance that already exists by the pollution of our streams. When the time comes, as it must come, when all cities and towns shall be placed on the same footing in regard to this matter of the pollution of streams, then we will

* From a paper before the Connecticut Engineering Society.

probably be in a financial condition to erect a pumping plant and construct filter beds. The natural advantages for such a plant within 500 feet of where the sewer now enters the river are very great.

No especially difficult engineering problems were met in carrying on the work. The sore point, or the work on which most stress was laid and the inspectors instructed to be most particular about, was tight joints, a very necessary characteristic of the separate system of sewers.

CURRENT INFORMATION.

Imminent Gas War in Hamilton, Ohio.

Mr. John Lorenz, superintendent of the municipal gas plant at Hamilton, O., makes the following statement regarding the gas situation in that city to a representative of Municipal Engineering:

The city of Hamilton is again in the courts in legal contest with a private corporation, the Hamilton Gas Light and Coke company, on account of the city's ownership of its own gas works.

In order that this struggle between private and municipal ownership, at present, may be well understood, a brief recital of conditions leading up to the building of the municipal gas works will be of assistance.

Until 1855 Hamilton was lighted by primitive methods. Then came the organizers of the Hamilton Gas Light and Coke company, who secured a franchise, without limit as to time, and the city of Hamilton, to help the organization, subscribed for its stock to the amount of $5,000. Everything went well until 1887, when the gas company and the city authorities began to clash on account of the failure of the company to extend mains into the new additions of the rapidly growing city. A demand for a reduction in the price of gas was likewise made by the city and refused by the company.

After going to much trouble to prove that they could not make and sell gas in Hamilton for $1.50 per thousand, as demanded by the council, they came forward with an offer to supply the city lamp posts and buildings at $1.50 per thousand. The people by a large majority decided at an election to build their own gas works. At the time this action was taken by the citizens of Hamilton they were paying to the gas company one-fourth of all the money raised by taxation to defray the expenses of the city. Special legislation was not required to enable the city to build its own gas works.

After the legal battles and preliminaries, during which the gas company had fought the city from court to court, the city was found to be clearly in possession of the right to proceed.

Finally in 1890 the city gas works were completed, and on the 30th day of April of that year gas was supplied for the first time from them. The price of gas was at once placed at $1 per thousand. The price of gas has gradually been reduced until at present it is 80 cents per thousand cubic feet, and the gas company has kept on in the business, notwithstanding its former protestations that it could not sell gas at a profit at $1.50 per thousand. In 1898 the writer became superintendent of the city gas works, and in the annual report for that year and also in that for 1899, after going over the situation carefully, made a recommendation that the city purchase the gas company's works.

The gas company then came to the city with an offer to make a lease or operating contract under which it was to operate the city gas works as well as its own. This application was not given consideration

The gas company thereafter devised a plan to introduce the Otto coke process and perfected arrangements to build a fifty-oven plant just north of the city.

The coke company, being a separate organization, laid its pipe line along the right of way of the C., H. & D. R. R. Co. to the city limits, and the gas company, starting at the city limits, laid the main down to a point within 3,000 feet of its works.

Upon discovering the intention of the gas company to connect its works with the Otto coke company's pipe line the city threatened to arrest its men if they did not cease to dig up the streets. The gas company enjoined the city from executing its threat and the city asked for injunction to stop the work. Both injunctions were allowed.

The city at once passed an ordinance to make it necessary for anyone desiring to open the streets for any purpose to secure permission first from the board of control.

The case of the city vs. the gas company to enjoin the work of laying the pipe was heard and dismissed, the court holding that the company had the right to lay the pipe. The gas company at once started laying the mains without regard to the ordinance. The board of control through the mayor had the workmen arrested, and the gas company promptly had the board of control and the mayor cited for contempt of court, claiming a violation of the injunction to prevent interference. The case was heard, and the judge fined the members of the board of control, the mayor and the chief of police each $10 and the costs. The gas company now promises to bring in Otto gas and reduce the cost.

Electric Lights for Small Cities.

Electric street lighting in small cities was the subject of a paper read before the Iowa Engineering Society by Prof. G. W. Bissell of Ames, Ia., who expressed himself as doubtful that the small city had followed the best plan for lighting the streets. He said that in his part of the country, at least, lighting was obtained from arc lamps hung at street intersections, or by incandescent lights of 16 to 32-c. p., distributed in the same way, or by a combination of the two systems, arc lights being used in the thickly built and the incandescent lamps

in the outlying districts. He cites that the average arc lamp costs about $15, which would buy 75 16-c. p. or 50 32-c. p. incandescent lamps, neglecting cost of installation. The power of one arc lamp would furnish power for 10 16-c. p. or 6 32-c. p. incandescent lamps, and no trimming or cleaning is required. On the other hand, the mean spherical candle-power of a 1,200-c. p. arc lamp is 400, while incandescent lamps run with the same power would furnish not more than half that amount. He believes that, all things considered, 16-c. p. incandescent lamps distributed at regular short intervals on both sides of the street would give better distribution of illumination than the system now most generally used. In blocks of 400 to 500 feet there should be four 16-c. p. lamps, two on each side, alternating along the block with those on the other side. The lamps should be carried on neat iron posts with brackets so as to carry the lamp about twelve feet above the sidewalk. They should be installed on the series system with shunt boxes. The wiring should be lead-covered cable laid underground in galvanized iron pipe, sewer tile or wooden troughs, about two feet below the surface. Prof. Bissel said this system would cost more than the present generally used system, but the result would be more satisfactory as far as illumination is concerned, and these would be in addition to the advantage of dispensing with overhead wire and unsightly supporting poles.

Electric Wires Must Go Underground in Baltimore.

The electrical commission of Baltimore, Md., served notice on the electric companies Feb. 13, to place all overhead electric wires, except trolley wires, under ground in the city's conduits before the end of the present year. In accordance with the law, 150 days will be given the companies in which to complete the work, and, that they may have all the time needed, these 150 days will be reckoned from March 31, thus making the date of expiration Aug. 28. If at the end of this time all poles are not down the electrical commission is authorized to "chop or saw them down, or remove them," which Mayor Hayes says will be done.

Oakland Water Companies' Consolidation Is Legal.

A decision rendered by Judge Hart, Jan. 22, prevents the city of Oakland, Cal., from making any inquiries about the consolidation of the Contra Costa water company and the Oakland water company, or about the water rates that existed prior to the consolidation. The attorney for the city attempted to show that the companies consolidated for the purpose of raising the rates, and that such action was contrary to law. He claimed the right to produce evidence about the former rates on the ground that the evidence would have a bearing upon the price said to have been paid by the Contra Costa company for the Oakland company's property, and that it would tend to show that the Contra Costa company was able to supply the city with water without drawing on the Dingee wells. The attorneys for the Contra Costa company relied upon a supreme court decision that water companies may combine and that the combinations are not illegal, for the reason that the city has the right to fix the water rates. The attorneys also held that the matter of competition had nothing to do with property values or with the question whether both plants were needed in supplying water to the city.

In ruling against the city, Judge Hart stated that he had no doubt in his own mind that the two water companies combined for the purpose of doing away with competition, but the motives for the consolidation had nothing to do with the case before him. Even though the consolidation was effected by fraud or for fraudulent purposes, the only question before him was whether the rates now charged were reasonable and proper. The testimony about the consolidation and the subsequent increase in rates was, therefore, declared to be inadmissible.

Issue of Bonds for Municipal Water Works in Denver Illegal.

A decision rendered by Judge Riner of the United States district court Feb. 11, declares the bonds voted for two years ago for municipal water works at Denver, Colo., are illegal. The judge held that the proposed bond issue is illegal because it was voted at a special election; because the people voted on two contrary propositions to buy or to build; because the city made a 20-year contract for water with the Denver Union Water company in 1890, which does not expire for nine years. The judge, while holding that the city itself cannot build works, does not say it may not allow a second company to do so.

Water Meters Recommended for Buffalo by Superintendent Illig.

The report of Frank J. Illig, superintendent of the bureau of water, Buffalo, N. Y., on the subject of water pumpage rates and meters in that city, shows a total during 1900 of 39,920,777,100 gallons of water pumped, equal to a daily average of 109,371,992 gallons, or a per capita consumption of 273 gallons, based on a population of 400,000 inhabitants. Since 1895 a marked increase in pumpage has occurred, the pumpage for that year being 34,000,000,000 gallons against 39,000,000,000 gallons for 1900, an increase of 5,000,000,000 gallons.

The report states that Buffalo leads the United States in per capita consumption, and says: "This would be commendable

were the water actually used; but we are aware that great quantities (at least two-thirds of pumpage) are wasted. The remedy for this is closer and more frequent inspection and the gradual introduction of the meter system." The report shows that, on account of the great waste, the revenue from water pumped shows Buffalo at the foot. Cleveland, Chicago and Detroit earn $35.34, $35.21 and $29.22, respectively, per million gallons, while Buffalo earns only $18.97, less than 2 cents per 1,000 gallons, on present basis of rates. Were this great leakage stopped, estimated at two-thirds of all the water pumped, the rate could be reduced 25 per cent. to the individual householder.

The importance of reducing the water rates is pointed out by Superintendent Illig, who holds that a decrease in water and an honest decrease in price to consumers will be obtained by the judicious installation of more meters. He points out that the use of meters in Detroit, introduced in 1886, has enabled that city to hold its pumpage at a stationary figure for ten years, although the population has increased 75,000. This indicates a fixed consumption for ten years with a 56 per cent. increase in population and a per capita decrease from 203 to 130 gallons. This was accomplished by metering about 5,000 consumers of a total of 49,000, and while the effect is marked, the per capita supply still shows large waste and can be reduced by increasing the number of meters.

The increase in the use of meters in Washington has had a similar but no less marked effect. The existing law requires the use of meters only by hotels, livery stables, manufacturing establishments and other large consumers. Since 1894 all such consumers have been required to use meters. With an increase since 1894 of 4,355 in the number of premises supplied with water, the total daily supply is reduced about 4,000,000 gallons and the per capita supply from 181 to 164 gallons. This can be attributed to no other cause than the metering of about 500 large consumers of the above named character. Superintendent Illig makes comparisons as follows:

Milwaukee, with a population of 280,000, has 25,689 meters and per capita consumption of 85 gallons; Toronto, population 200,000, has 17,000 meters and a per capita consumption of 95 gallons; Toledo, 135,000 population, has 4,297 meters and a per capita consumption of 54 gallons; Buffalo, with an estimated population of 400,000, has 114 meters and a per capita consumption of 273 gallons.

Raising a Water Main Under Pressure in Louisville.

The raising of a 30-in. water main under pressure a maximum hight of 9-ft., was accomplished recently at Louisville, Ky., under the direction of Charles Hermany, chief engineer and superintendent of the Louisville Water company. The work was done as follows: Fifteen pairs of transverse beams were laid across the trench above consecutive joints, and supported over the pipe by short longitudinal blocks on each of which a fifteen-ton jack was set. On top of each jack was hung a long U-shaped stirrup which had its lower ends hooked into the upper ends of saddle bars engaging the pipe. The pipe was raised a few inches at a time by the simultaneous operation of the jacks, and the earth was backfilled and tamped under it as fast as it was raised. The displacement was checked and regulated by observations of vertical scales set on the pipe and intersected by the edges of the horizontal cross-beams. It took a gang of fifty men the equivalent of three weeks to do the work, including the time on excavation of the trench and backfilling.

Conviction for Chicago Stock Yards Water Thefts.

Harry Boore, superintendent of the Continental Packing & Provision company, Chicago, Ill., was found guilty, Feb. 18, of stealing 187,000 gallons of water from the city mains in the stock yards for the use of the packing company. The value of the water was fixed at $14.96. This sentence will be for petit larceny, the punishment for which is a fine not to exceed $1,000 and imprisonment not to exceed one year. The trial and conviction of Boore was the first resulting from a recent examination of the city water mains in the stock yards district, in which it was discovered that the mains had been illicitly tapped in many places, and millions of gallons of water taken.

Experiments with Septic Tanks in Pawtucket, R. I.

A record of investigations of the septic-tank treatment of sewage is given in the anuual report for 1900 of George A. Carpenter, city engineer of Pawtucket, R. I. The works were built by Mr. Carpenter several years ago and their operation began Dec. 1, 1894. The sewage filtered daily has increased from an average of 58,200 gallons in 1895 to 92,800 gallons in 1900, an increase of about 62 per cent. The actual filtering area on Jan. 1, 1895, was 1,648 acres. In August, 1895, 0.256 acre was added, and in November, 0,437 acre, bringing the total up to 2.34 acres. The area has not been increased since Nov. 1, 1895, except by two experimental beds, which have a surface area of 1-200 acre each. The maximum daily average for a single month has increased in the same ratio from 82,548 gallons in 1895 to 132,622 gallons in 1900. These figures indicate that at times the beds have to deal with over 40 per cent. more than the average daily flow for the year, and this in-

creased amount of the sewage always occurs in the colder months, when the beds, on account of climatic influences, are not in the best condition for dealing with the greatest quantity of which they are capable.

The application of sewage to the beds has been at the rate of 100,000 gallons per acre, and the beds have been used in rotation. In January, 1900, when filtering the largest amount of sewage, most of the beds were used twice in three days, thus making the average daily dose 66,666 gallons per acre. In the winter months this heavy dosing, with the present system of underdrains, one line of 4-inch tile pipe in the berm dividing two beds, keeps the beds pretty thoroughly saturated.

An appropriation was obtained from the city council in July, 1900, and four of the beds were supplied with additional underdrains. Across each of these four beds two additional lines of 4-in tile were laid about 20 ft. apart. The total width of these four beds is about 60 ft. Although the effluent now passed through the beds more rapidly than formerly, the analyses show that the quality has not deteriorated. In order to ascertain how much they can purify in a satisfactory manner during the winter season, sewage is now supplied to these four beds every day except Sunday. The work of the sand filters has been highly satisfactory during the whole of the six years that they have been in operation, and an effluent much better than the river into which it flows has been obtained.

The sewage is received in two tanks 130x 100 ft.x3 ft. deep, and after a tank has filled the upper 2.5 feet is discharged on the sand beds, and the lower 6 inches which represents a somewhat heavier sewage, on account of sedimentation, is let out on what are termed sludge beds. These sludge beds are similar to the other sand beds only they are somewhat smaller. The heavier matter in the sewage retained on the surface of these sludge beds is dried and raked up and wheeled away to a compost heap. Measurements of the dried sludge removed from the surface of these beds have shown that, after thoroughly compacting by ramming, it amounts to about 3.15 cubic yards per million gallons of sewage received in the tanks. On the surface of the other sand beds there is very little accumulation, and the discolored sand is scraped off and removed about twice each year.

For the purpose of ascertaining how much sludge would accumulate in a septic tank, how often it would have to be removed, what its character would be, how much it would cost to remove it, and what effect the effluent from the sludge beds would have on the sand filters, one of the receiving tanks was turned into a septic tank on Jan. 13, 1900, and has been used as such ever since. No change was made in the tank except to provide an overflow which would take the effluent from the tank about 17 ins. below the surface and discharge it into the other tank. The analyses show that 41.5 per cent. of the organic matter, as represented by the albuminoid ammonia, has been removed by the septic tank. The analyses also indicate, by a comparison of the total residue on evaporation, that 37.733 parts per 100,000, or 1.868 cu. yds. of mineral matter per million gallons of sewage have been left in the septic tank.

Mr. Carpenter states that after ten months' operation of the septic tank the sewage in this tank was drawn off, the sludge carefully measured, loaded into barrows and wheeled about two hundred feet to a field where it was taken by a farmer, spread on the surface and plowed in. The amount of sludge which had accumulated in ten months was 152.17 cubic yards. About 4.69 cubic yards of this was sand which had collected near the inlet, which left 147.18 cubic yards as the amount of sludge collected from 27,166,000 gallons of sewage, or 5,428 cubic yards per million gallons. Analysis of the sludge shows 81.75 per cent. of water, which leaves but 26,915 cubic yards, or 0.99 cubic yards per million gallons, as the actual amount of mineral and organic matter left in the tank. This would indicate that the septic action, in some manner, disposed of the difference between 1.865 cubic yards per million gallons and this amount. This difference is 0.878 cubic yards per million gallons, or 23.85 cubic yards for the ten months the tank was in service. The cost of removing this sludge was $62.87, or $0.41 1-3 per cubic yard. The cost of scraping the surface of the sludge beds, on which the sewage from the septic tank was turned when it was emptied, which amounted to $7.07, should be added to this, making the total cost of cleaning $69.94, or $0.459 per cubic yard.

These tanks are covered with a pitched roof boarded and shingled and provided with ventilators, but no disagreeable odors emanated from the septic tank. There was a large amount of gas given off by the effluent from the septic tank as it discharged into the second or collecting tank, and as it was again discharged from there to the beds, but nothing that could be termed a nuisance or that would be very marked 500 feet distant from the plant.

For experimental work in connection with the septic tank two bacterial filters were constructed, each 15 by 15.5 feet by 4 feet deep. On the bottom of each filter were placed two rows of 2-inch tile underdrains about 5 feet apart. These pipes were surrounded and covered with clean gravel of assorted sizes with fine white roofing gravel for the top layer. The total depth of the gravel was 8 inches. On top of this gravel in one bed, No. 14, 3 feet and 4 inches of

crushed stone of the size known as chestnut were placed. In the other bed, No. 15, 3 feet 4 inches of soft coal cinder which would pass through a screen of 1-inch mesh but would be rejected by a screen of ⅛-inch mesh, were deposited. On these two beds sewage from the septic tank has been turned each week day since March 12, 1900, at the rate of about 527,000 gallons per acre, or about 100 gallons per cubic yard of filtering material in the beds.

The following table gives the averages of chemical examinations made by the State Board of Health from April 16 to October 1, 1900:

AVERAGES OF CHEMICAL EXAMINATIONS MADE BY THE STATE BOARD OF HEALTH FROM APRIL 16 TO OCTOBER 1, 1900. (PARTS PER 100,000.)

	Residue on Evaporation.			Ammonia.				Chlorine.	Nitrogen as		
					Albuminoid.						
	Total.	Loss on Ignition.	Fixed.	Free.	Total.	In Solution.	In Suspension.		Nitrates.	Nitrites.	Oxygen Consumed.
Sewage, average of 18 analyses	102.017	59.889	42.128	7.811	1.442	0.805	0.637	11.073	.....	.....	17.572
Septic sewage, average of 20 tests	64.990	32.425	32.565	7.595	0.846	0.621	0.225	9.556	.....	.....	8.525
Effluent of sand filters, av. of 13 tests.	49.223	17.461	31.762	1.432	0.083	0.061	0.022	8.856	2.6750	0.0426	1.073
Effluent of bact. filter 14, av. of 9 tests.	49.911	17.244	32.667	4.777	0.434	0.296	0.138	9.819	0.0153	.....	4.222
Effluent of bact. filter 15, av. of 9 tests.	47.922	15.089	32.833	4.444	0.414	0.288	0.126	9.772	0.0157	.....	3.533
Percentage improvement by:											
Septic tank	.....	.....	.....	2.7	41.3	.....	.....	.....	.....	.....	51.5
Septic tank and sand filter	.....	.....	.....	81.7	94.2	.....	.....	.....	.....	.....	93.9
Septic tank and filter 14	.....	.....	.....	38.8	69.9	.....	.....	.....	.....	.....	76.0
Septic tank and filter 15	.....	.....	.....	43.1	71.3	.....	.....	.....	.....	.....	79.9

The analyses indicate that the effluent from bed No. 15 contains 51.1 per cent. less albuminoid ammonia than the septic effluent, or 71.3 per cent. less than the original sewage, and that nitrification has been established.

On Sept. 11, 1900, experiments in the aeration of the septic sewage applied to both beds were begun. This septic sewage was pumped to a hight of about twelve feet and allowed to fall through three screens of one-eighth-inch mesh placed two feet apart to the distributing well, from which it was run to the beds. The result of this aeration was the introduction of 50 per cent. of dissolved oxygen into the sewage.

A slight improvement in the effluent has been noticed. Two smaller bacterial filters have been constructed by filling two cans twenty inches in diameter and six feet high with filtering material, one with coke and the other with cinders similar to bed No. 15, and the effluent from bed No. 15 has been turned on these.

Although it is too early to give the results of any large number of analyses of the effluent from the new filters, those that have been made show a reduction in the albuminoid ammonia and an increase in nitrates to 1.48 parts per 100,000.

Frequency of Discharge of Flush Tanks.

I have read from time to time articles about flush tanks and how often they should be discharged. We have thirty automatic flush tanks on our sewer system.

When I took charge of this system of sewers in connection with the water works I found the tanks were discharging in some instances twice an hour. The regulation was accomplished by the ordinary rough stopcock. The water had cut the core of many of them so they would not shut off the supply. It was quite plain to me that some other means of regulating the supply should be adopted. I concluded that a jet was the surest way to feed the tank, and for this purpose I used a ¾-inch cast iron plug with a whole drilled through it of varying size but about 1-16 of an inch in diameter.

The plug is screwed into a T, one opening of the T being connected to the pipe inside the tank, the other one having a ¾-inch rough stop cock attached from which a handle extends to near the top of the tank within reach. The tanks are examined about once in three weeks, and in order to see that they are operating, the rough stop is opened, the tank thus filling quickly.

My experience with tanks on our system is that in order to keep them in continuous operation they should be discharged not less than three times daily (24 hrs.). While perhaps the sewer may not require flushing that often, yet in order that the tank shall work continuously, which is fully as important, I find this rate is necessary. It is an easy matter to get the proper flow into the tanks by the size of the hole in the plug. They are inexpensive, and after a few trials the proper size can be determined. Since adopting this system we have had no trouble and the quantity of water used is greatly reduced.

The trouble in not being able to discharge the tanks less than three times daily is not due to the failure in the water supply, but in the siphon failing to act. The water rises in the tank to the level of the long limb or a little higher and unless the supply is increased it will fail to discharge. Naturally one would look for a leak in the tank, but this is not the case, as I examined the tanks for leaks. I found water running from the outlet pipe of the siphon. I have never fully satisfied myself what was the real cause of this action, but I have sometimes thought that it was caused by the air escaping from the bell through some leak, thus destroying the operating feature of the tank. I have another theory to offer on which I hope someone will express his opinion. This theory is that the water rises in the bell to near the top of the long limb. A thin fillet of water around

the outer edge of the long limb, due to capillary attraction, is a little in advance of the main column of water; this water flows over the edge of the long limb and down the inner edge of the limb without displacing any of the confined air in the bell and limb, thus running into the outlet pipe. The trouble with the supply pipe clogging up, it seems to me, would be in a measure overcome by the inspecting of the tanks, as the opening of the stop-cock full open each time would flush out the pipe.

Within the last year I have had some trouble with roots in sewer pipe, mostly from elm and willow trees. To remove them I used a flat piece of steel formed in a spiral, the edge of the bar being sharpened. It has worked admirably. These little wrinkles may be old to most of your readers. However, I offer them, hoping they will be of interest to someone who may be in the same predicament I have been.

EDWARD M. LAING,
Supt. Water Works and Sewers, Highland Park, Ill.

This letter from a correspondent and subscriber is an interesting contribution to the discussion on the waste of water by flush tanks. It is probable that the design of the flush tank or some small error in the detail of setting is responsible for the failure of the tank to discharge when the supply of water is very small. There are tanks so designed that when properly set they will discharge when full, no matter what the rate of flow of the supplying stream, but almost any tank, if not properly set, will be subject to the failure of discharge with small stream for one or the other of the reasons mentioned by him.

Dady's Havana Claims Settled.

The payment of $250,000 to Michael J. Dady, Jan. 29, settles the controversy between Mr. Dady and the military and municipal governments of Havana, Cuba, regarding the contract for paving the sewers in that city. Mr. Dady gave a bond of similar amount that he was authorized on behalf of the Dady company to make the settlement and to release all claims.

Preliminary Supreme Court Decision on Stream Pollution by Chicago Drainage Canal.

The United States supreme court rendered a decision Jan. 28, in the case of the state of Missouri vs. the Sanitary district of Chicago, in which it was held that the city of St. Louis must be given an opportunity to come into court and show that the operation of the drainage canal will pollute that city's water supply. The sanitary district of Chicago expended $34,000,000 in building the drainage canal, which was objected to by the city of St. Louis on the ground that the filth of the Chicago river would be carried through the Desplaines and Illinois rivers and thence down the Mississippi, to pollute the city's water supply. The sanitary district contends that flowing water purifies itself by the principle of oxidation, and it will stand or fall on this principle.

The opinion was handed down through Justice Shiras, who said that two questions are presented in the case. The first is "whether the allegations of the bill disclose a case of controversy between the state of Missouri and the state of Illinois and a citizen thereof within the meaning of the constitution and the statutes of the United States which create and define the original jurisdiction of this court;" the second, "whether if it be held that the allegations of the bill do present such a controversy they are sufficient to entitle the state of Missouri to the equitable relief prayed for." Regarding the first question, the court concludes:

An inspection of the bill discloses that the nature of the injury complained of (the pollution of the drinking water of people of Missouri by the deposit of the sewage of Chicago into the Mississippi river through the drainage canal and the Illinois river) is such that an adequate remedy can only be found in this court at the suit of the state of Missouri. It is true that no question of boundary is involved nor of direct property rights belonging to the complainant state. But it must surely be conceded that if the health and comfort of the inhabitants of a state are threatened the state is the proper party to represent and defend them. * * * The health and comfort of large communities inhabiting those parts of the state situated on the Mississippi river are not alone concerned, but contagious and typhoidal diseases introduced into river communities may spread themselves throughout the territory of the state. Moreover, substantial impairment of the health and prosperity of the towns and cities of the state situated on the Mississippi, including its commercial metropolis, would injuriously affect the entire state.

That suits brought by individuals, each for personal injuries, threatened or received, would be wholly inadequate and disproportional remedies requires no argument.

On the point that Illinois should not have been made a party to the bill and that the sanitary district of Chicago should have been made the only defendant, he says:

The bill does not allege that the sanitary district is acting without or in excess of lawful authority. The averment and the conceded facts are that the corporation is an agency of the state to do the very things which, according to the theory of the complainant's case, will result in the mischief to be apprehended. The sanitary district of Chicago is not a private corporation formed for the purpose of private gain, but a public corporation whose existence and operations are wholly within the control of the state. The object of the bill is to subject the public work to judicial supervision upon the allegation that the method of its construction and maintenance will create a continuing nuisance, dangerous to the health of a neighboring state and its inhabitants. Surely in such a case the state of Illinois would have a right to appear and traverse the allegations of the

bill, and, having such a right, might properly be made a defendant.

Regarding the second question he says:

Can it be gravely contended that there are no preventive remedies by way of injunction or otherwise against injuries inflicted or experienced but which would appear to be the natural result of acts of the defendant, which he admits or avows it to be his intention to commit?

Our conclusion therefore is that the demurrers filed by the respective defendants cannot be sustained. We do not wish to be understood as holding that in a case like the present one, where the injuries complained of grow out of the prosecution of a public work authorized by law a court of equity ought to interpose by way of preliminary or interlocutory injunction, when it is denied by answer that there is any reasonable foundation for the charges contained in the bill.

We are dealing with the case of a bill alleging in explicit terms that damage and irreparable injury will naturally and necessarily be occasioned by acts of the defendants, and where the defendants have chosen to have their rights disposed of, so far as the present hearing is concerned, upon the assertions of this bill. We fully agree with the contention that it is settled that an injunction to restrain a nuisance will issue only in cases where the fact of the nuisance is made out upon determinate and satisfactory evidence; that, if the evidence be conflicting and the injury be doubtful, that conflict and doubt will be ground for withholding an injunction, and that, where interposition by injunction is sought to restrain that which is apprehended will create a nuisance of which its complainant may complain, the proofs must show such a state of facts as will manifest the danger to be real and immediate. But such observations are not relevant to the case as it is now before us.

The demurrers are overruled and leave is given to the defendant to file answers to the bill.

The ruling of the court seems to give cause for gratification to both sides, for each claims that the contention will now be tried on its merits.

The Grade Crossing Question in Cleveland.

A special committee of the Chamber of Commerce, Cleveland, O., has submitted a report on the abolition of grade crossings in that city. The committee reports that there are 135 crossings of steam railways with streets at grade, of which twenty-nine are in streets bearing street railways, twenty-nine on main streets without surface railways and the remaining seventy-eight are on streets with comparatively light traffic. Observations were made at three important crossings and the result was given in the report in the form of a census, by hours, and for twenty-four hours of an average day. At the combined Euclid-ave. and Willson-ave. crossing, during twenty-four hours, 9,831 pedestrians, 6,020 ordinary vehicles, and 1,303 street cars, crossed the railway tracks. The two classes of vehicles contained a total of 33,119 passengers. The committee noticed delays caused to pedestrians and passengers at this combined crossing, with the following conclusions:

Each street railway car is delayed half a minute on account of the crossing, either on the Euclid or Willson lines, during an average day of seventeen hours; and 100 trains delay traffic a total of two hours and eighteen minutes, or one and one-third minutes per train. It is thus found that 1,207 pedestrians, 740 vehicles and 4,068 passengers were delayed one and one-third minutes each on account of trains, at a cost of $19.964; also that 33,119 passengers were delayed one-half minute each, at a cost of $27.654; a total cost of $47.618 per day, which in one year amounts to $17,380.57, or 5 per cent. on about $350,000.

At the other two crossings the delays, when capitalized, would warrant the expenditure of $106,000 for Detroit-st., and $142,500 for Pearl-st. Railway companies in Ohio cannot be compelled, under existing laws, to aoblish grade crossings, but in case an agreement for such action is reached the law requires steam railways to pay not less than 65 per cent. of the cost and prohibits municipalities from paying more than 35 per cent. Street railways are not compelled to pay a cent. In conclusion the committee makes the following recommendations:

1. That the legislature be requested to pass a law requiring street railroads to pay not less than 25 per cent. of the expenses of abolishing grade crossings used by them.

2. That the legislature also be requested to pass a law providing for the appointment of a grade crossing commission, to be composed of the governor, auditor of state and commissioner of railroads, who shall have authority in event of its satisfactorily being made to appear to them that a municipality has been unable to agree with any railroad company with respect to the abolishment of its grade crossings, to determine, after full hearing being given the parties interested, as to the necessity of abolishing such crossings and as to the terms and conditions upon which the same should be done, including the apportionment of the cost thereof upon the parties interested.

3. That the mayor be requested to appoint a committee of seven representative citizens, who shall serve without compensation, to consider and report plans for the abolishment of all grade crossings in this city, and to confer with the proper representatives of the various steam and street railroad companies with a view to inducing them to agree upon the adoption of mutually satisfactory plans and to contribute their just proportion to the cost of making such improvements.

4. That to pay the legitimate expenses of such committee, including the expenses of employing competent engineers to make the necessary surveys and prepare plans and estimates to that end, the council be requested to appropriate the sum of $10,000.

Report of Massachusetts Topographical Commission.

In its report to the governor, the Massachusetts topographical commission estimates that it will require eight or ten years more to complete the topographical work in the state. Massachusetts is the first state

to undertake this work on so complete a scale, and many vexed questions of boundary lines have already been determined and disputes settled. The boundaries between Massachusetts, New York and Rhode Island are also being marked. The commission, which serves without pay, is composed of the following: Desmond Fitzgerald, chief engineer of the Metropolitan Water Board; A. E. Burton of the Massachusetts Institute of Technology; Frank W. Hodgson, engineer of the harbor and land commission.

Proposed Insertion of Contractor's Label in Chicago Pavements.

An ordinance approved by the special assessment committee of the Chicago city council Jan. 31 provides for protection against contractors in the following manner: "A plate of burnished steel, to be not smaller than 6 by 15 inches, nor larger than 10 by 24 inches, will hereafter be placed at the intersections of newly paved streets. The plate will set forth the name of the street, the date of the completion of the work of paving, the date of the expiration of the guaranty made by the contractor to the property-owners, the name of the contractor and the following inscription: Report defects or needed improvements to the commissioner of public works, city hall." Alderman Fowler is the originator of the idea.

Paving Commission Proposed for New Haven.

A bill will be introduced in the Connecticut legislature providing for a paving commission for New Haven. The bill provides that the paving commission shall consist of five men, of which three shall be appointed by the mayor, one by the Board of Aldermen and one by the Board of Councilmen. The members of the commission are to serve without pay, but a clerk is provided for at a salary not to exceed $500. The clerk will be appointed by the commission. The commission will have nothing to do with crushed stone pavement, as it is not classed as permanent pavement, but will only have power over the laying of permanent pavements, such as brick or asphalt.

New Jersey Road System.

A report on the New Jersey road system was prepared for the Springfield union recently by William L. Dickinson of Springfield, Mass., president of the Connecticut Valley Highway association. Mr. Dickinson, who practically lived with the men who make the roads and with the people who have to pay for making them, has gathered the following interesting facts:

New Jersey state aid law in operation since 1891. Its satisfactory working has caused other states to adopt it. System praised by United States road inquiry board. One hundred and sixty miles of splendid state road between Jersey City and Atlantic City. State has not incurred a debt in giving road aid to towns.

Four hundred and forty miles of state road built prior to Jan. 1, 1900, at a total cost of $2,200,000, or about $5,000 a mile. Of this amount the state paid $716,000, the counties paying the remainder. Some roads, ten feet wide and with eight inches of crushed stone, have been built for $3,000 a mile. Many miles of fourteen-foot roads have been built for $4,000 a mile. In some sections thin macadam roads have been built for $1,500 a mile. Cost of some of the first roads was $9,000 a mile, which careful management has gradually reduced to the present low cost.

Particular attention paid to the reduction of grades, especially in the hilly section of the state.

State road laws provide for a supervisor in each county. These supervisors are practical road builders. They work under the general direction of the state commissioner, Henry I. Budd.

Cost of the roads has not been a burden. They have increased both the valuation and population of the state.

State road commissioner spends one day each week in his office in Trenton and devotes the rest of his time to inspecting and supervising the work. He has one assistant in this work. His office force consists of one clerk.

Mr. Dickinson says the building of continuous stretches has been found to be the most economical. The longest continuous line built in 1900 was 23.26 miles, and the largest mileage built in any one section was 34.34 miles. The cost for 1900 shows a slight increase on account of the advance in price of crushed stone, resulting from the combination of the different firms dealing in the material. The railroads also charge more for transportation. There is an absence of suitable stone for macadamizing in many sections of the state, and the crushed stone has to be carried by rail a long distance. The stone oftentimes costs $1.50 per ton delivered on the railroad, and it costs 25 to 50 cents per ton to deliver this where the work is to be done. This brings the cost of the roads up very materially; so do deep cuts made to reduce the grades and underdrains used to secure proper drainage. Different methods and materials have been used according to the conditions existing in the different localities.

Public Improvements in Indianapolis.

The reports of the boards of public works, public safety, health, the city police and fire surgeon, and the veterinarian of Indianapolis, Ind., were submitted to Mayor Taggart Feb. 4. The board of public works makes a number of recommendations, including the following: A municipal asphalt repair plant; that the electric lighting contract, which expires in 1903, be taken up this year that there will be no embarrassment if the present company is not the successful bidder; that Pogue's run and the state

ditch be cleaned. Attention is called to the decrease in public improvements last year on account of the litigation which stopped improvements for six months. The report says:

The whole matter of sewers will be brought to the attention of our representatives in the general assembly, and it is confidently hoped that proper relief may be granted. In this event, it is also our intention to provide West Indianapolis with an adequate system of sewers.

The board believes that the street railway system compares favorably with that of any city in the union. Regarding the repair of permanently improved streets the report says:

There was placed at the disposal of the board for this purpose the sum of $25,000, and there was expended of this sum $17,807.46. Repairs were made where, in the judgment of the board, they were absolutely necessary, but it might be added that the whole amount of the sum appropriated, and much more, could have been used had all the requests made upon us for this purpose been heeded.

This problem is destined to become a serious and perplexing one, as the necessity of the work is sure to grow with the expiration of the contractors' guarantees. It is the opinion of the board that the city's interests (so far at least as asphalt repairs are concerned) can best be subserved in this matter by securing an asphalt repair plant, and it is the intention of the board to give this phase of the situation some thought and consideration.

For sweeping and cleaning improved streets the sum of $50,000 was appropriated, out of which must come the pay of inspectors, amounting to $1,920 annually. The report says it was found that this sum would not be sufficient to do the work as thoroughly, i. e., to scrape the streets and sweep them as often as necessary, but the best possible schedule under the circumstances was arranged, and while at intervals the streets were not as clean as might have been desired, when the number of miles of surface to be kept clean is compared with the sum appropriated for the purpose, we believe that the board has every reason to felicitate itself upon its success in keeping the streets in the good condition in which they were kept and yet live within the appropriation.

Under the provisions of a legislative enactment the unimproved streets were, so far as possible, sprinkled at the expense of the municipality. The sum of $40,000 was appropriated for the purpose, from which the salary of one inspector must be deducted.

The annual report of B. J. T. Jeup, city engineer of Indianapolis, Ind., for 1900 sets out in detail all the work accomplished in his department, not only for that year, but during the last ten years. He states that the improvements contemplated during 1900 were delayed on account of the decision of the Federal court, which held that the Barrett law is invalid. Later the supreme court upheld the law, but the delay caused a postponement of many of the improvements contemplated earlier in the year. During the year .72 mls. of asphalt, 1.24 mls. of brick and 9.2 mls. of wooden block pavement were laid and 7½ mls. of sewers were constructed. In 1899, 9.37 mls. of sewers were constructed. The report says an amendment to the city charter provisions on sewers has been proposed governing the methods by which assessments are to be made for the construction of large sewers. The present charter is defective in that it provides that in the construction of large sewers the assessment per unit of area is equal over the entire district drained by the sewer. The proposed amendment provides that the board of works shall have power to make assessments according to actual benefits received by each piece of property included in a district. The report states that 7.34 mls. of cement sidewalks were laid and a number of streets were resurfaced and repaired during the year.

The improvements accomplished during the last ten years are as follows:

Area of Indianapolis in square miles	27.09
Miles of streets and alleys paved with asphalt	41.66
Miles of streets and alleys paved with brick	24.27
Miles of streets and alleys paved with creosoted pine blocks	7.99
Miles of streets paved with round cedar blocks	.54
Miles of streets paved with Washington cedar blocks	3.06
Miles of streets paved with Washington cedar blocks not creosoted	1.86
Miles of streets paved with macadam	4.04
Total	83.32
Miles of sewers	98.60
Miles conduit laid:	
Indianapolis Light and Power Co	17.75
Central Union Telephone Co	4.99
New Tdephone Co	5.34
Western Union Telegraph Co	3.53
Total	31.61
Number electric lights in city	1,226
Number vapor lights	259
Number gas lights	142
Miles street railway lines	125

The following table shows the total number of miles of improvements and the aggregate cost for ten years:

	Miles.	Cost.
Asphalt	41.56	$2,550,625 31
Asphalt repaved	.77	69,004 02
Brick	24.27	932,476 36
Wooden block	13.35	757,270 77
Macadam	3.70	154,522 91
Gravel streets	75.50	657,648 02
Gravel alleys	11.92	33,274 09
Bowldered alleys	4.77	11,990 09
Cement walks	125.08	608,414 42
Brick walks	25.99	65,995 41
Sewers	98.60	1,627,385 31
Levees		17,725 46
Bridges		185,804 81
Total		$7,669,136 98

Utilization of Refuse and Garbage for Fuel in England.

The utilization of refuse in connection with electrical schemes is embodied in a report which has just been prepared by F. W. Brookman, manager of the Rochdale (England) sanitary works. The municipal electricity works at Rochdale have been in use only a few months, and arrangements have now been made for the production of current for the tramways, which the corporation will soon take over from the existing company. Both the gas and electricity works are in charge of one committee. It it believed that the committee's intention is to extend the plant at the present generating station so as to be able to supply the current that may be required for all purposes. Mr. Brookman, in his report opposes this view, and advises a separate power station for tramways at the sanitary works, where the refuse might be fully used as fuel. Rochdale was one of the first towns to use refuse systematically for the generation of steam. Mr. Brookman says that about ten years ago a number of towns had destructors in operation which burned refuse, but the number which got any appreciable amount of power out of it could be counted on the fingers of one hand. With the coming of the high temperature furnace great power was quickly made, and destructors now provide for all kinds of work, including the following:

Electric lighting, electric traction, mortar mills, working baths and bathhouses, making bricks and slabs, pumping water for town's supply, working pressing plant for sewage sludge, etc.

Refuse is burned for one or other of these purposes at the following, and many other places: Canterbury, Leeds, Colne, Huddersfield, Dewsbury, Sheffield, Fleetwood, Leicester, Llandudno, Ashton, Leyton, Birmingham, Rotherhithe, Manchester, Streatham, Nottingham, St. Helens, Stretford, Liverpool, Warrington, Glasgow, Wimbledon, Aldershot, Burton, Shoreditch, Blackburn, Southampton, Darwen, Bradford, Hereford, Oldham, Hunstanton, Edinburgh, Shipley.

Mr. Brookman says that plants of various sizes and for various purposes are being made by the dozen at the present time. At Rochdale the excreta have been manufactured into manure for many years, and for a long while had a ready sale in agricultural districts. The demand has fallen off of late, however, and Mr. Brookman says it is only a question of time when the manufacture will be entirely stopped. When that time arrives the refuse that is now burned to generate steam for the manure manufacturing process will be wholly available for other purposes. Detailed reports are given of tests made at Rochdale, St. Helens, Darwen and Nelson, which, he says, prove conclusively that not only can unscreened refuse and foul garbage be completely burned without creating any nuisance, and producing a hard, dry clinker suitable for many purposes, but that such refuse is a valuable source of power. The estimate of Lacey & Co., that six pounds of refuse are equal to one pound of coal at 7s per ton, is accepted by Mr. Brookman. At the Rochdale Sanitary works about 20,000 tons of refuse are received every year, the fuel value of which is thus equal to 3,333 tons of coal. Not only would this be wasted, but it would cost in labor alone nearly £1,000 to waste it, unless the burning process could be made to serve some useful purpose. Mr. Brookman says:

While we are paying £1,000 per annum to waste the equivilent of 3,333 tons of coal (which is worth considerably over another £1,000), if the tramways committee obtain the electrical energy they require from the present electrical works, the electricity committee will purchase not less than another £1,000 worth of coal to generate the energy required to work the trams, and will, of course, employ labor to burn this totally unnecessary quantity of coal.

He contends that, even apart from the advantage to be derived from the utilization of refuse as fuel, it is economical to have a separate power station for the tramways. Mr. Brookman has been through the accounts of 74 local authorities who have generating stations, and he finds the average cost of coal to be .76d per unit sold. The average cost of the management and office expenses, insurance, etc., is, on the other hand, only .453d per unit sold.

Meeting of Indiana Engineering Society.

The twenty-first annual meeting of the Indiana Engineering Society, held at Indianapolis Feb. 14, 15 and 16, was an interesting and successful meeting notwithstanding the prolonged illness of the secretary, his work being assumed and ably carried out by President J. S. Spiker. The engineering field was well covered by the papers presented, and liberal selection from them will appear in our columns. The session of the afternoon of the 15th was devoted to cement and concrete and was more than usually interesting, including papers on "The Manufacture of Portland Cement," by S. B. Newberry; "The Strength of American Slag Cement," by Prof. W. K. Hatt; "Concrete Construction As a Substitute for Brick and Stone Masonry," by Victor K. Hendricks, Engineer Maintenance of Way, T. H. & L. R. R. These were all practical papers by experts in the respective subjects.

Important papers were those on "Stream Pollution," by A. J. Hammond, formerly a city engineer, and on "Sewage Disposal," by F. A. Barbour, civil engineer. These were of special interest in view of the bills now before the Indiana legislature on the subject. One of these bills was prepared by

the state board of health and provides for a careful and scientific study of each particular case as it arises and an intelligent supervision of the streams of the state. After a careful consideration of this bill the society adopted a resolution favoring its passage. Another bill, which has already passed the senate, provides for a written permission, limited as to duration, to be issued by the state board of health to any one proposing to pollute a stream, such permission being a bar to any liability for damages unless specific damage can be proved in an action at law. This bill fails to provide the proper machinery for the state board of health to prepare and to enforce its decisions, and while the society considered its indorsement of the former bill sufficient formal action, members expressed themselves as opposed to the latter bill owing to its fragmentary and unscientific character and the possibility of serious errors in its practical application.

Other valuable papers were those on "Street Paving," by John Finan, jr.; "The Mississippi River Commission Surveys," by Prof. C. V. Seastone; "Railroading in Great Britain," by Prof. R. L. Sackett; "Relations of Engineer and Contractor," by R. L. Bailey; "The Design and Construction of Masonry Arches," by Prof. W. D. Pence; "The Condition of Engineering Work in Lebanon," by John W. Fulwider.

The officers elected are; President, Prof. W. D. Pence, Purdue University, Lafayette; Vice-President, Prof. R. D. Sackett, Earlham College, Richmond; Secretary and Treasurer, Charles Carroll Brown, Editor Municipal Engineering, Indianapolis. Directors: J. S. Spiker, Civil Engineer, Vincennes; F. W. Keller, County Surveyor, South Bend; C. G. H. Goss, Civil Engineer, Martinsville.

Cedar Rapids Water Cases.

The contract of the city of Cedar Rapids with the water company expired Feb. 19, 1900. The city failed to pay its hydrant rental for 1899 and 1900 and the water company obtained judgment for the amount. An attempt to regulate water rates before the contract expired was prevented by injunction, the court holding that the fixing of rates was a matter of contract and could not be done by one party only.

The city had plans for a municipal system prepared, but found the cost was greater than it was allowed to raise, as the amount required would cause the city's indebtedness to pass the limit.

An ordinance was then passed and submitted to the people, proposing to grant a franchise to J. H. Brown and agreeing to pay him $38,000 a year for hydrant rental, other water for public purposes to be furnished without charge, these payments to continue for twenty-five years, when the works would become the property of the city. This proposition was favorably passed upon by the voters, but in taking the final steps in the council the clause turning the works over to the city at the end of the period named was dropped out. Suit was brought to enjoin the council from completing the contract and the decision of Judge Treichler was rendered Feb. 16 declaring the franchise unreasonable, illegal and void and restraining the city from making any contract under it. The amount heretofore paid for all public serivces has been not more than $16,527 a year, and there has been no complaint of inadequate compensation. Under the Brown franchise the rate to private consumers would have been lowered materially, and the present water company resists the reduction of rates to the same figures without the compensating increase in hydrant rentals offered the Brown company.

Report of Filtration of Water Supply for Washington, D. C.

A report on the purification of the Potomac river water for the supply of the District of Columbia was submitted to the Senate District committee, Feb. 19, by Messrs. Rudolph Hering, George W. Fuller and Allen Hazen. The use of slow sand filters with auxiliary works for preliminary sedimentation and the use of a coagulant part of the time according to the modified English system is recommended. Regarding the plans already made, the report says:

"As to the relative merits of the two systems of purification studied by Colonel Miller, namely, the treatment of plain subsided waters by sand and mechanical filters, his conclusion is correct that the latter system would be the more efficient and the more judicious one for the City of Washington to adopt. Since his investigations were instituted, some improvements have been made in the general processes of both slow and rapid filtration. Relative to the former, this progress applies, for very turbid clay-bearing waters, when needed. This procedure was studied at length at Cincinnati and is used at a number of small places in Europe. It is referred to in Colonel Miller's report as the modified English system. It was not investigated by him owing to lack of funds, and in the absence of practical results he did not consider it."

The Venezuelan Asphalt Controversy.

On Feb. 20 the New York and Bermudez company, owning the first asphalt concession granted citizens of the United States by the government of Venezuela, filed a brief with the Department of State setting forth its claims. The company claims that the contention "is not between two American companies over a boundary line, but that the immediate parties are the government of Venezuela and the New York and Bermudez company, the former having attempted to sell to some of its citizens a right previously granted to the lat-

ter. That the disputed title was purchased by American citizens does not affect the status of the case. There is a flagrant denial of justice which the United States is justified in interfering to prevent. The case should therefore be treated by international methods, thus removing it from the jurisdiction of the Venezuelan courts." The company asserts its desire to submit the case in its present state to an impartial international tribunal rather than ask the United States government to resort to extreme measures. The reply of the other parties interested in the disputed concession has not yet been received.

The Asphalt Situation.

Mr. George C. Warren of Utica, N. Y., formerly the general superintendent of the Warren-Scharf Asphalt Paving company, gives the following account of the combination of asphalt companies recently announced:

About a year and a half ago a syndicate consisting of Gen. Francis V. Greene, Amzi L. Barber, William L. Elkins, P. A. B. Widener and a few other capitalists bought controlling interests and subsequently all of the stock of the Warren-Scharf Asphalt Paving company, the Utica Paving company, the Barber Asphalt Paving company, the Columbia Construction company, the Alcatraz Asphalt company, the Western Paving and Supply company, the Pennsylvania Asphalt Paving company, the Gilson Asphaltum company of New Jersey, the New Jersey Mexican Asphalt company, the Manhattan Trap Rock company, and quite a number of other asphalt companies and their sub-companies. With this property in their possession, they organized the Asphalt company of America, with a paid-in capital of $3,000,000, which was subsequently increased to $6,000,000, and having also as assets the stock of all the companies purchased. The bonded indebtedness of the new company was $30,000,000. Within the past few months the Asphalt company of America was organized as the National Asphalt company. The Asphalt Paving company of America as such has laid no pavements, the work being done by its subcompanies. Some of the asphalts controlled by the National and its allies are the Trinidad, Pitch lake, Bermundez lake, Mexican, the several California asphalts known as Alcatraz, Standard and others, and the Seyssel, French asphalt. In Trinidad, in addition to the Pitch lake, the new company owns about nine-tenths of the town of La Brea, in which the so-called land asphalts are located. It is understood that by absorbing the many old companies the new company will dispense with the services of about two hundred former employes, retaining enough to do its work.

Prominent among the number are Mr. Warren himself, and Mr. S. Whinery, M. Am. Soc. C. E., for many years a vice-president of the Warren-Scharf Asphalt Paving company and its acting president during the transition period of the combination. The combination of local branches heretofore maintaining separate organizations materially reduces the expenses of the parent company and will enable them to do their work more economically.

C. M. Warner and P. R. Quinlan of Syracuse, the prime movers in the Columbia Construction company, which is one of the companies absorbed, have now obtained a concession from Venezuela to take asphalt from territory contiguous to that controlled by the Bermudez Asphalt company, also absorbed, and a contest over the boundary line between the concerns is now almost an international question.

The Warner-Quinlan company of Syracuse, the Cleveland Trinidad Paving company, or the newly incorporated Trinidad and Bermudez Asphalt company of Cleveland, the R. F. Conway company or the International Asphalt company, recently incorporated with Mr. Conway as a prominent member, of New York, are operating independently, and are equipped with material, apparatus and capital to continue in the field of competition.

Among the companies in independent operation, either for the supply of material or as contractors for work, are the Uvalde Asphalt company of New York, the Assyrian Asphalt company of Chicago, the Union Oil company of San Francisco, the Southern Refining company of Los Angeles, the Globe Asphalt company of Pittsburg, the United States Paving company, formerly the Boston Paving company of Boston; Jewett & Blodgett of Bakersfield, Cal.; Green River Asphalt company of Louisville, Ky.; Ayres Asphalt Paving company of Zanesville, O.; Sicilian Asphalt Paving company of New York, Southern Asphalt Paving company of New Orleans, La.; W. S. P. Shields of Philadelphia, and the Federal Asphalt company of Chicago.

Any statement of conditions in the asphalt field must be regarded as representing simply the best available information at the time. In addition to the changes in progress involving old companies, the plans as to new companies are likely to bring interesting developments in the near future, and further information may be expected in future issues.

Technical Meetings.

The eighth annual meeting of the Michigan gas association was held in Grand Rapids Feb. 20 and 21. The program included the following papers: "Neglected Opportunities," by B. C. Cobb, Detroit, Mich.; "Inclosed Cluster Lights With Self-Igniters," A. L. Zwisler, Kalamazoo, Mich.; "Street Maps; Their Use and Abuse," Paul Challis, Adrian, Mich.; "New Business," J. C. Sloan, Port Huron, Mich.; "The Relation of Heating and Illuminating Gases, Especially as Applied to Incandescent Mantles," Herman Russell.

The Western Society of Engineers held its

regular meeting Feb. 8. Prof. Hermann Von Schrenk of the Shaw School of Botany, St. Louis, Mo., presented a paper on "Factors Which Cause the Decay in Wood," and H. P. Boardman of the Chicago & Alton railway presented one on "The Substitute for the Glasgow Bridge."

The Electrical Engineers' association of Syracuse university, Syracuse, N. Y., met Feb. 7 and reorganized the society on a new plan. H. R. Stevens, Fred Phillips, Geo. C. Carhart, R. W. Copeland and W. H. Squires were appointed a committee to draft a new constitution and to include certain qualifications for membership. Wesley L. Curtis was elected president and H. R. Stevens vice-president. The association will not be generally open to all electrical students hereafter, as it has this year. No students will be taken in during the first semester of their freshman year.

The twenty-first annual convention of the Iowa Brick and Tile association was held at Boone, Ia., Feb. 20 and 21.

The seventeenth annual meeting of the Ohio Gaslight association will be held in Dayton, O., March 20 and 21. F. C. Jones, secy., Delaware, O.

The Iowa Electrical association held its annual meeting in Des Moines, Ia., Feb. 20 and 21.

The annual convention of the Minnesota Surveyors' and Engineers' society was held in St. Paul Feb. 20 and 21.

The February meeting of the New England Water Works association was held in Boston Feb. 13. Attention was called by Wm. R. Grace, superintendent of the water works at Rockland, Mass., to a bill now before the Massachusetts legislature providing that unpaid water rates (due to a city or town) shall be a lien on the estate. He urged all who are interested to attend the hearing before a committee and present arguments for or against the measure. A review of "The Rise and Development of Water Supply Sanitation in the Nineteenth Century" was presented by Prof. Wm. T. Sedgwick of the Massachusetts Institute of Technology.

The regular monthly meeting of the Civil Engineers' Society of St. Paul, Minn., was held Feb. 4, 1901. The following officers were elected for the ensuing year: President, A. O. Powell, Asst. Eng. U. S.; Vice-President, A. W. Munster, Bridge Eng. C. G. W. Ry.; Secretary, G. S. Edmondstone, City Bridge Engineer; Treasurer, A. H. Hogeland, Res. Eng. G. N. Ry.; Librarian, C. A. Winslow, City Engr's office, St. Paul; Representative on Board of Managers for Association of Engineering societies, George L. Wilson, Asst. City Engineer, St. Paul. Mr. H. J. Gillie, superintendent Edison Electric Light company, described the terminal station within the city of St. Paul of the electric current generated at the power house of the St. Croix Water Power company at its dam upon Apple river.

A Small Gravity Sand Filter at Nyack, N. Y.

In a paper before the American Society of Civil Engineers, Mr. G. N. Houston, an associate member, presents a description of the construction of a small gravity sand filter for the villages of Nyack, South Nyack and Upper Nyack, N. Y., which have a combined population of about 8,000. The village of Nyack purchased the water works in 1897 by condemnation proceedings and after a series of experiments and studies in other directions decided upon a gravity sand filter for Hackensack creek water, most of the former supply having been drawn unpurified from the stream.

The filter consists of two beds each of 8,200 square feet area and a pure-water reservoir with a capacity of 44,000 gallons. It is wholly in excavation, with earth embankments to protect it from high water in the creek. The walls are concrete for 3 ft. 8 ins. above the bottom, thence a vitrified brick paving on a slope of 1½ to 1 for a vertical hight of 4 feet. The bottom is of concrete, the regulating and intake chambers are of brick, the division wall between the two beds is of concrete below the sand and of brick above. The filtering material is 3 feet of sand on top of 1 foot of gravel with 6-inch tile pipe for drains. Each bed has a main drain of tile pipe leading to the regulating chamber. The pure water well is of brick with a bottom of concrete. It is separate from the filter but connected with the regulating chamber by a 12-inch cast iron pipe.

The bottom 6 ins. of the filtering gravel is 1 to 3 ins. in greatest diameter; the next 3 ins. is ½ to 1 in.; the top 3 ins., 1 in. and less. In one-half the bed the gravel is washed gravel, in the other half the lower 9 ins. is crushed trap rock and hard field stone. On top of the gravel the sand is placed.

The water was wasted the first week the filter was put in operation. It was then pumped into the reservoirs, although still quite turbid. The turbidity disappeared in about three months. The rate of filtration is regulated by the pumps, which draw from the pure water well to supply the reservoirs. They run at a uniform rate for at least 9 hours a day. The maximum consumption is at the rate of 630,000 gallons a day, giving a maximum rate of filtration with one bed in use of 3,326,000 gallons per acre per day. This rate is never reached as both beds are used except when one is being cleaned, which has not occurred at time of maximum pumpage. The development of some springs is reducing the amount of filtered water required and the introduction of meters is reducing the consumption. The beds were finally completed in May, 1900.

The cost of the filters, increased somewhat by an intermission in construction, was $29,091.

The Wright Demand System of Measuring Electricity.

The officials of the United Electric Light company at Springfield, Mass., expect to have the new system of measuring electricity known as the Wright demand system, installed and in operation by March 1. It will be necessary to keep the system working for a month in order to determine what rates can be made after that time. It is believed that the rate will be 18 cents for the first 1,000 Watt hours, with a secondary rate of 8 cents for each 1,000 Watt hours thereafter. This will be the primary rate for all consumers ranging from above 40 hours' use of monthly demand in winter to above 20 hours' monthly in summer. The rate will be still further reduced according to larger amounts used and the conditions governing the service. Under the present system the general rate is 23 cents per 1,000 Watt hours, with the following discount to consumers of 25,000 Watt hours, 20 per cent.; 50,000, 30 per cent.; 100,000, 35 per cent; 200,000, 45 per cent. Other larger discounts are given depending on the conditions under which the electricity is applied.

A Decision in Utah on Underground Water.

A decision was rendered at Salt Lake City, Utah, Jan. 28, by Judge Rolapp, in the case of the Herriman Irrigation company vs. George W. Keel et al. The action was to restrain the defendants in their mining operations through the Butterfield tunnel from interfering with the flow of water from the plaintiff company's springs. Judge Rolapp's decision was in favor of the defendant. In his opinion the flow from the tunnel is percolating and seepage water, and not from the Herriman Irrigation company's springs. He finds further that Keel and the other defendants have never taken more than their share of water, but he suggests that a commissioner be appointed to divide the waters at the headgate, the commissioner to have the same powers conferred by a former decree of the court.

State Highway Laws Do Not Apply to Kansas City Streets.

The court of appeals, at Kansas City, Mo., handed down an opinion Feb. 4th in the case of Margaret Kerney vs. the Barber Asphalt Paving company in which it held that the laws of the state regarding highways do not apply to the streets of Kansas City, because the enabling act providing for the formation of charter cities gives those cities exclusive control of streets and alleys.

While driving a buggy on the city's streets Mrs. Kerney met a big steam roller owned by the Barber company. Its clanking noises and escaping smoke and sparks frightened her horse, causing it to run away and throw her out, injuring her. She brought suit against the company and obtained a verdict for $1,250 under the state law requiring portable engines on a public highway to stop within 100 yards of an approaching team and remain still until the horses were past. The Barber company appealed the case, and the judgment of the lower court was reversed on the ground that there was no law requiring portable engines to stop for fear of frightening horses.

Olmsted Park, Boston.

The park commission of Boston has joined Leverett and Jamaica parks and given the name of Olmsted park to the entire area, in honor of Frederick Law Olmsted.

Prize for Plan for Reclaiming Newark Salt Meadows.

Alexander C. Chenoweth of New York City has been awarded the third prize for reclaiming the meadows within the limits of Newark, N. J. The plan is to extend a dyke along five miles of water front, and to divide the 3,000 acres back of the dike into four separate drainage sections. Surface drains will conduct the water to four pumping stations discharging into Newark bay. The November, 1900, issue of Municipal Engineering described the plans receiving the first and second prizes.

Gleanings from Reports of Municipal Officers.

In the annual report of the committee on streets and sewers of the common council of Plainfield, N. J., is a history by Joseph O. Osgood, C. E., of the processes of sewage purification by septic tanks and contact beds, which gives a very clear, condensed statement of their development. It is proposed to utilize the existing sewage purification beds, with an area of about two and one-fourth acres, which have not been very successful, for two septic tanks, each 50x100 feet, and with water six feet deep, and eight contact beds each 92x106 feet, with concrete walls and floors, filled four feet deep with stone one inch or less in diameter and one foot of coarse material. Sewage runs through two beds in succession by the double contact system. It is expected that this plant will prove sufficient for 900,000 gallons of sewage per day, and that the expense will be $1,500 a year. There is area enough remaining to quadruple the plant now planned when it becomes necessary.

The report of the trustees of the Piqua, O., water works states that the water supply was introduced for fire protection, sprinkling and boiler service and domestic use was a secondary consideration. This is still true to some extent. The receipts during the year ending May, 1, 1900, were $9,568.05, and the expenses of operation were $5,144.32,

leaving a balance of $4,423.73. Of this amount $3,126.56 was spent for extensions and for driven wells to increase the supply of water. The total cost of the works to date is $119,931.30, but the city is deriving power from a hydraulic canal which cost $268,911.64 additional. No charge is made to the city for public uses. An estimate of the value of this service places it at $9,900 a year, which is probably a somewhat greater amount than would be paid a private company for the service; for example, six flush tanks for sewers are charged at $200 each, but fire hydrants are charged at $40 each. The original cost of the works, $56,896.84, was paid by the city, and some of the additions, which have nearly doubled the cost of the works, have also been paid by the city. The sum of $9,900 a year wipes out the interest and the indebtedness at quite a rapid rate. Considerable additions must be made at an early day, and the new supply will be more suitable for all purposes, including domestic water supply. W. B. Mitchell is secretary of the board.

The report of the board of water commissioners at Watertown, Wis., shows receipts $6,605.86. Of this amount $1,376.05 was spent in new construction and improvements, the remainder, except $170.01, being the cost of operation, repairs and maintenance. The city pays nothing for public uses, but it is supposed to maintain a hydrant fund which can be used to pay the bonds of the works as they become due. The works have cost $115,043.19. Of this amount $90,000 is represented by bonds of the water company from which the works were purchased, which fall due at the rate of $3,000 a year, and $10,000 by bonds issued by the city, of which $4,000 are yet outstanding. The coal bill is $1,535.94. A little over 35 per cent. of the taps for services, 384 in number, are metered and about the same proportion of the total consumption is metered. Three-fourths of the metered water is furnished to the railroads and about one-tenth to public buildings. The increase in number of meters during the year was about 25 per cent. Julius Fix is superintendent and William F. Voss is secretary.

Middletown, N. Y., is a city with a population of about 15,000, securing its water supply by gravity, with a little aid from pumps drawing from wells to reservoir in dry seasons. The water works have cost $421,304.93. A report was made in September, 1900, estimating the cost of desirable additions to the supply at $190,000. A mechanical filtration plant is under construction to improve the quality of the water, upon which about $13,000 has been expended to date of report. The cost of operating the filter plant will be from $2,000 to $3,000 a year. There are 2,026 taps, of which 129 are metered. The receipts in 1899 were $37,602.01. The operating and maintenance cost was $6,540.13. It was not necessary to run the pumps during the year. When they are run they cost $3,000 a year. Operating expenses have run as high as $11,000 a year. The cost of running filters must hereafter be added. The works paid nearly $20,000 on construction account, over $8,000 interest and $2,000 for bonds during the year. The city is charged nothing for public uses. An estimate of the saving to the city on this account makes it $10,610 a year. This is a rather low estimate, hydrants being charged at $40, flushing sewers at $100 a year, schools $150, etc. The meter rates are low, especially in large amounts, ranging from 15 cents per 100 cubic feet to 4 cents per 100 cubic feet. A discount of 25 per cent. is made to all meter users for payment of bills in 60 days, and to manufacturers the discount is 50 per cent. Notwithstanding the low rates it is apparent that the water taker, especially at flat rates, pays more than his shore of the city's expense. T. W. Davey is superintendent and James M. Hill secretary.

The report of the board of water commissioners of Norfolk, Va., shows receipts of $209,748.05 during the year ending June 30, of which $108,114.35 is from water rents, $70,841 is from sale of bonds and $13,752.83 from proceeds of water tax. The expenditures were $211,656.11, of which $99,278.88 was for operating expenses and maintenance, including $53,236.10 on filter plant, $50,538.73 for extensions and improvements, and $61,839 for interest and bond payments. A new mechanical filter plant was constructed in 1899 costing $109,515.96 and having a capacity of 8,000,000 gallons a day. The superintendent calls attention to the great waste of water and the advantages of the meter system in stopping it and so postponing the day when large additions must be made to supply and to filter plants. At the lowest meter rate, 10 cents per 1,000 gallons, the revenue from the water pumped should be $187,140, showing a loss of at least $79,026. The average consumption and waste is 111 gallons per capita. A full description of the filter plant is included in the report. A new 10,000,000 gallon pumping engine is needed. The average daily pumpage is 5,127,124 gallons. H. L. Smith is superintendent and Geo. W. Wright is chief engineer of the plant.

This report was referred by the select and common councils to the city engineer with the request that he reply to the questions, the estimated cost of relieving the present situation, the cost of installing meters, and his judgment as to the most effective and best solution of the matter. In a report dated Jan. 28., 1901, the city engineer, W. T. Brookes, gives an estimate of $169,154 for new supply main, $10,000 for new centrifugal pump and boilers for pumping to filters and $1,000 for repairs to supply pump, a total of $180,154, and adds

that in a very short time a new service pumping engine, new boilers, addition to filters and new subsidence basin will be necessary at a cost of $78,000, making in all $258,154. For the second question he estimates 7,600 meters for ⅝-inch service pipes at $13.50 and 400 for ¾-inch pipes at $17.50, a total of $109,600, the expenditure of which will be distributed over a number of years. For the third question, after marshaling a large number of facts and opinions of experts, he pronounces judgment emphatically in favor of meters. The argument which he presents is practically unanswerable and can only be overcome by a prejudice so strong that it cannot be removed by the most direct appeal to the pocket-books of consumers and taxpayers.

New Publications.

Street Pavements and Paving Materials. A manual of city pavements, the methods and materials of their construction, for the use of students, engineers and city officials. By Geo. W. Tillson, M. Am. Soc. C. E., Asst. Engr. Department of Highways, Brooklyn, N. Y. Octavo, 544 pages, 60 figures, cloth $4. New York: John Wiley & Sons.

Mr. Tillson has made a very satisfactory effort to cover the field defined in the title of his book. A short history of the development of pavements is followed by a chapter on the kinds of stone from which pavements are made, including those used for broken stone in concrete. In the nature of the case this can not be given in sufficient detail to cover variety of local material, but it mentions the more important kinds of stone. A digest of the discussions upon the nature of asphalts and descriptions of the more prominent asphalts and asphaltic limestones and sandstones, and similar treatment of the clays and shales used for making paving brick give outlines for more detailed study of these materials. The chapter on cement and concrete is longer and will not be considered entirely satisfactory from a theoretical standpoint, but practically will be a safe guide if not always clear. The chapter on the theory of pavements is probably that upon which the author has expended most thought. It opens with a historical statement of the various materials that have been used for pavements and then discusses the relative weight of cheapness, durability, ease of cleaning, resistance to traffic, slipperiness, ease of maintenance, and favorableness to traffic in determining the kind of pavement which shall be chosen, and gives examples of methods of combining these elements for streets of various kinds. The effect of making openings in pavements is also discussed briefly. About 200 pages are filled with illustrated descriptions of methods of construction of various pavements, with statements of cost of actual work. There are chapters on cobble and stone block, asphalt, brick, wood and broken stone. While each engineer of experience will find some points in which he differs from the author, the chapters all give examples of good practice and present standards of good construction for the guidance of municipal officials, the effect of which is not marred by suggestions of cheaper methods of doing work. The chapters on brick and macadam are perhaps less satisfactory than the others. A valuable chapter is that discussing the reason for the various requirements of contractors made in the usual general specification. Full construction specifications for all the materials mentioned are also given, also methods of construction of street car tracks. The important questions of widths of roadways and sidewalks, grades, curbing, material for sidewalks, are discussed in sufficient length. There is also a short chapter on asphalt plants.

Proceedings of the Milwaukee Conference for Good City Government and Sixth Annual Meeting of the National Municipal League, held Sept. 19-21, 1900, at Milwaukee, Wis. Clinton Rogers Woodruff, Editor, 286 pp. cloth. Office of Secretary, Girard Building, Philadelphia.

The valuable papers and the discussions of them at the Milwaukee meeting are given in full in the volume. Time spent in study of them by all interested in good city government would be well spent. The new municipal program which has been under discussion by the society for some years received its full share of attention with papers on various phases of it by Joshua Stark, Charles Richardson and Samuel E. Sparling. Wm. Dudley Foulke took a prominent part in the discussions and there were papers by John F. Burke and Washington Gladden on the influences of public service corporations on city government and legislation. Uniform municipal accounting also received much attention with papers by M. N. Baker, James B. Cahoon and Harry B. Henderson. The League always prints a few more copies of the proceedings than are needed to supply its members and they can be obtained at a low rate from the secretary.

Personal Notes.

Martin Lutz has been appointed city engineer at Celina, O.

A. B. Tracy has been appointed city engineer at St. Albans, Vt.

A. B. Mader has been appointed city surveyor at Prescott, Ariz.

John B. Ansley has been elected city engineer at Americus, Ga.

C. J. Corcoran has been elected city clerk at Lawrence, Mass.

Hon. James H. Cisney, mayor of Warsaw, Ind., died Feb. 10 of pneumonia.

Major O. B. Gunn, C. E., Kansas City, Mo., died Feb. 18 of stomach trouble.

Dow R. Gwinn has resigned his office as superintendent of the Quincy Water Works,

Quincy, Ill., to accept that of president and general manager of the Terre Haute Water Works company, Terre Haute, Ind.

L. B. Denison has been appointed chief engineer of the sewerage system at Delaware, Ohio.

John D. Merrill has been elected president of the common council at Cambridge, Mass.

George W. Howell, city engr. at Morristown, N. J., died at his home in that city Feb. 15.

Harold Fraser has been appointed superintendent of the gas and electric light works, Brockville, Ont.

Charles A. Sweet has been appointed city engineer at Syracuse, N. Y., to succeed Russell R. Stuart, resigned.

N. K. Connolly, engineer of the Jersey City Water Supply company, Jersey City, N. J., died Feb. 9, aged sixty years.

George H. Boughman has been appointed chief engineer of the surveyor's department of the city of Wilmington, Del.

D. R. Shirk has been appointed superintendent and engineer of the Elizabethtown Water company, Elizabethtown, Pa.

A. G. Carpenter, formerly county surveyor, has been appointed city engineer at Olathe, Kas., to succeed Fred A. Pickering, resigned.

William Gavin Taylor has been appointed city engineer at Medford, Mass. Mr. Taylor has been acting city engineer during the last year.

S. A. Mitchell has resigned his position as assistant city engineer at Kansas City, Mo., and will enter into private practice with offices in the New York Life building.

O. L. Nichols, principal assistant engineer of the new East River bridge, lectured before the Technical Society of Brooklyn Feb. 15 on "The New East River Bridge."

J. D. McKay has been re-elected president of the Iowa Falls Electric Light and Power company at Iowa Falls, Ia. W. H. Courtney was elected vice-president and F. E. Foster secreatry.

Palmer C. Ricketts, M. Am. Soc. C. E. and director of the Rensselaer Polytechnic Institute at Troy, N. Y., was elected president and trustee of the institute Feb. 19 to succeed Hon. J. H. Peck, resigned.

Ambrose Howard Carner, managing director of the New York & Bermudez Asphalt company, and V. M. Backus, representative of the Warner-Quinlan Asphalt company, Venezuela, have arrived in New York City.

George Matt has resigned as general manager and secretary of the Lancaster Electric Light company, and the Lancaster Gas, Light & Coke company, Lancaster, O., and is succeeded by his son, Edward Matt.

P. W. Henry, Assoc. M. Am. Soc. C. E., vice-president and general manager of the Barber Asphalt Paving company, delivered an address before the students of the Rensselaer Polytechnic Institute at Troy, N. Y., Feb. 15 on "A Sketch of the Asphalt Paving Industry."

Thomas Downs has resigned his position as mechanical engineer in charge of the water system of the city of Chicago, having accomplished the work assigned to him when appointed four years ago to organize and systematize the water works and various pumping stations. Mr. Downs will engage in private business.

A. Wilfred Zahm has resigned as secretary and general manager of the Manhattan Light, Heat and Power company at St. Paul, Minn., to become general manager of the Light, Heat, Transit and Public Service company at St. Cloud, Minn.

Mayors have been elected in the following cities and towns: Jacob Phinizy, Augusta, Ga.; Dr. T. B. Bullard, Palmetto, Ga.; W. J. Outlaw, Pratt City, Ala.; I. P. Delmas, Scranton, Miss.; R. S. Adams, Oxford, Miss.; M. M. George, re-elected, Lithonia, Ga.; Nathan Emanual, Brunswick, Ga.; F. M. Weed, Ocean Springs, Miss.; Grant Graham, Piedmont, W. Va.; Dr. John E. Toole, Bainbridge, Ga.; R. L. Moye, re-elected, Cuthbert, Ga.; William C. Burgess, Auburn, N. Y.; C. W. Rich, Hattiesburg, Miss.; J. W. Strickland, Concord, Ga.; L. D. Borders, Brookville, Tenn.; Edgar B. Stewart, Morgantown, W. Va.

SELECTIONS FROM THE PRESS.

Street Lighting.

The problem of the lighting of our streets in the best possible manner is one that is deserving of more serious attention than it generally receives. The numerous recent improvements both in sources of light and diffusing globes enable us to obtain brilliant street lighting at even less cost than the dingy lighting of twenty years ago. The public has a hazy notion that, by using the electric arc, far more light is obtained than when gas lamps are used, at no extra cost. When they find out from the corporation account that street lighting by electricity is more expensive, they begin to think that they must have been mistaken, forgetting that in this case the extra cost is due to the far higher standard of lighting demanded. The choice of injudicious globes which cut off 40 or 50 per cent. of the total light generated is often also responsible for the increased expense. The financial aspect we shall not consider in this paper, contenting ourselves with the problem of how best to illuminate our streets. In practice, of course, each street has to be considered on its own merits, but there are a few general considerations which ought always to be borne in mind.

One of the first points that has to be considered is whether the horizontal illumination—that is, the illumination of the ground—or the vertical illumination—that is, the illumination of passers-by and vehicles—is the more important. In the early days of arc lamp lighting the securing of a uniform

horizontal illumination was what was aimed at. This was approximately obtained by placing powerful arc lamps at great hights from the ground. As an ordinary arc lamp gives out very little light vertically downward, and nearly all its light between angles of 20 degrees and 70 degrees with the vertical it is specially suitable for obtaining a uniform ground illumination. The great drawback to this method of lighting was the absorption of the light by the atmosphere, the slightest haze or fog absorbing most of the rays. The importance of this effect was not realized at first, but practical experience soon proved the necessity of lowering the lamps. This was a fatal objection to the various schemes for lighting towns by a series of lofty lighthouses which have from time to time been proposed.

Incandescent gas burners give out their light in quite a different way to arc lamps. Most of their light is given out horizontally, the candle power at 45 degrees being only one-third of what it is horizontally. Hence the vertical illumination produced by these burners is very good when they are not placed too high up. The perspective effect produced by a row of Welsbach lamps is distinctly good, as they are visible a long way off. With alternating current arc lamps, with the usual large shades fixed over them, this perspective effect is almost entirely lost, which greatly detracts from their appearance in a long street. Until, however, stronger mantles are invented, incandescent gas lamps are unsuitable for street lighting. After three months' experience at Leamington, they were discontinued, owing to the number of mantles broken by the vibrations caused by the traffic. In what follows we shall therefore confine our remarks to street lighting by arc lamps, as the electric arc is so well adapted for street lighting that there is no doubt that it will soon be more widely used than any other agent.

In practical work with arc lamps it is usual to plan the lighting so that the ground illumination will always be above a certain minimum, and in this case the vertical illumination is generally found to be sufficient. In many streets both in this country and abroad the arc lamps are arranged zigzag alternately on both sides of the street. This is an economical way, and, if the streets are narrow, it is fairly effective. Another favorite system in this country is to place arc lamps in refuges down the center of the street, and in wide, busy thoroughfares this is a good way, although we lose a considerable amount of the reflecting power of the walls of the houses, which is often a great help. A very effective way is used in Fifth-ave., New York, which is extremely well lighted. In addition to rows of arc lamps down each side of the street exactly opposite one another, there is a row down the center (sic) each lamp in this row being at the center of the rectangle formed by four neighboring side lamps.

Span wires attached to houses on each side of the street are sometimes used for suspending arc lamps, and this method is attracting a good deal of attention at present. In the principal streets of Milan the arc lamps are hung in this way from span wires at distances of sixty yards. Although these wires, as well as the overhead wires for the electric tramway, are unsightly in the daytime, yet at night the effect is excellent. It is also a decided advantage to get rid of lamp posts from the pavements.

For physiological reasons, if we have a brilliant lamp care must be taken that the light is well diffused. If we have a dazzling source of light, then the pupil of the eye partially closes, and so cuts off some of the rays that would have reached the retina had the light been better diffused, and as the effect of the illumination is proportional not only to the intensity of the rays that reach the retina but also to their number, it follows that increasing the intensity of the light may actually diminish the illuminating effect. This difficulty is always experienced when the electric arc is used, and hence many attempts have been made to get over it. The usual way of reducing the dazzling effect is to surround the arc with a good distributing globe. When opal globes are used the light is soft and diffused, but the absorption is considerable. It is a wasteful method to generate a light of 1,500-candle power, and then reduce it to 1,000 by using a semi-opaque globe; hence the attention of many engineers is directed toward inventing a globe which will not only refract the light in the best possible manner, but will diffuse it so thoroughly that the eye will not be dazzled by looking at it.

Mr. A. P. Trotter, the well-known electrician, invented some fourteen years ago his dioptric lantern, which had ten panes of glass covered with prismatic corrugations, the angles of which had all been carefully calculated so as to produce the best possible distributing effect. Unfortunately not only was it expensive, but it had a clumsy appearance, and so it was never extensively used. Yet the idea was good, and he may fairly claim to have been the first to prove how important it is to accurately design globes according to the laws of geometrical optics.

The Fredureau and Holophane globes have been designed and made in a very similar way to that employed by Mr. Trotter, but they are much more elegant than his, and are made in all shapes and sizes. The Holophane globes, about which so much has been heard lately, absorb very

little light, and yet the diffusion is almost perfect. Those used for street arc lamps are spherical in shape with horizontal prismatic ribs on the exterior, and vertical flutings on the inside, so that the light is thoroughly diffused in the interior, and then suitably distributed by the external prismatic circles. In Paris, on the boulevards between the Rue Hauteville and the Porte St. Denis, several of the arc lamps have these globes. The general aesthetic effect is good, and the mean illumination has been increased by their use. The practical objections to them are that they are divided into two parts, which need care in fixing together, and that it is difficult to keep them clean; for, like all prismatic globes, they are very apt to catch the dirt, and so need plenty of washing and scrubbing. This materially adds to their expense, for it is obvious that one trimmer could not attend to many of these lamps in a day.

The Fredureau globe is like the Holophane, except that it has no internal flutings, and hence the diffusion is not quite so good, the inside source of light appearing as a bright vertical band from the outside. Although these globes are dearer than ordinary ones, yet, as they enable us to save current, they may prove more economical in actual use.

Street lighting with glow lamps has not proved sucecssful on any large scale, and considering how much cheaper arc lighting is this not to be wondered at. What we have said hitherto applies to continuous current arc lamps. In the continuous current arc nearly all the light is emitted downward, the maximum intensity being 45 degrees with the vertical. With the alternating current arc as much light is sent upward as downward, so that it is equivalent to two small continuous current arcs, one being inverted. Up to the present time no thoroughly satisfactory way of utilizing the light of an alternating current arc has been found. The ordinary way of using large reflectors is objectionable, as at some distance off they shade far too much of the light coming from the lamp. Mr. S. Z. de Ferranti gets over the difficulty by converting the alternating current into a rectified one or current pulsating always in one direction, and using ordinary continuous current arc lamps. This method is a very popular one in this country. M. Blondel proposes to convert the alternating current into continuous by means of an alternating current motor driving a continuous current dynamo, but this way would be more expensive than the last.

Recently in America a lamp has been invented in which the carbons are placed parallel to one another, and the alternating arc kept at their lower ends by means of electro-magnetic repulsion. If this lamp works well it ought to greatly simplify the problem of how best to utilize the light of the alternating arc. It is still a vexed question with electricians as to whether the alternating current arc is less efficient than the continuous current arc or not. The general opinion seems to be that it is less efficient.

There is no doubt that brilliant sources of light and beautiful globes are desired by the public, and if globes like the Holophane prove a commercial success, a great impetus will be given to the efficient lighting of our streets. Rows of dingy lamp posts at present obstructing the pavements of the main streets of many towns could be removed and the streets effectively lighted by a few arc lamps in elegant globes, judiciously placed, without unduly burdening the rate-payer.—London Builder.

The Protective Power of Paints.

In a paper read some time ago before the Newcastle section of the Society of Chemical Industry, Mr. Henry Smith, F. I. C., described a series of very interesting experiments upon the comparative protective powers of different paints as applied to ironwork. Three series of experiments were made. In the first series a method originating with Mr. Max Toltze was employed. A number of iron dishes, 5 inches across and about ½ inch deep were cleaned and carefully painted with two coats of the paint to be tested. These dishes were then filled with water, which was allowed to completely evaporate at the ordinary temperature of the laboratory, after which the dish was again filled up, this operation being repeated six times in the course of six months over which the experiments extended. The paints used were prepared by grinding the pigments with linseed oil on granite rollers to a stiff paste, which was then thinned with best quality boiled linseed oil—itself capable of drying in seven hours to a hard film when painted on to a glass plate. Thus tested, the only paints which remained practically unaffected were red lead or orange lead paints, some of which, however, such as the "vermilionette" and the scarlet red paints, contained also a certain proportion of aniline colors; whilst two of the red-lead paints contained, in the one case 45 per cent. and in the other 66 per cent. of barytes. All the other dishes were more or less rusted, the order of merit of the better paints being as follows: 1. Zinc white. 2. Equal parts zinc white and barytes. 3. Zinc white, 3 parts; barytes, 7 parts. 4. Lithopone (a mixture of zinc sulphide, zinc oxide, and barium sulphate). 5. Pure white lead. 6. White lead, 5.37 parts; barytes, 4.03 parts. 7. White lead, 5.05 parts; barytes, 4.21 parts. All the other paints, 36 in number, proved very inefficient, the first dish

to show signs of rust being painted simply with linseed oil.

In the second series of experiments a number of painted iron plates were exposed to the weather for a twelvemonth, and with the single exception of the plate painted simply with linseed oil, all withstood the test remarkably well. In the third series of tests, strips of iron were painted, and when the second coat was quite dry these strips were placed in wide-mouthed glass bottles, which were then nearly filled with water and allowed to stand. The bottles were not closed, but the contents were protected from dirt by standing them under a shelf, there being about one-half inch of space between the top of the bottles and the underside of this shelf. The bottles were left untouched for three months. Some of the plates were sensibly affected within seven days; but those which successfully withstood the shallow-dish test also resisted this one most successfully. The fact that paints containing such large proportions of barytes, as some of the lead paints noted above, gave such excellent results is of much interest, as it goes to show that this material can hardly be considered as a mere adulterant. In fact, one paint made up only of barytes and linseed oil gave better results than an oxide of iron paint. Mr. Smith refers with approval to the methods adopted in painting the Forth bridge. All plates and bars for that structure were cleaned with steel scrapers and wire brushes and then coated with hot linseed oil. As soon as possible after erection they received two coats of red-lead paint, which were subsequently followed by two coats of iron oxide. The life of the paint on the upper portions exposed to the weather is found to be about three years, but it must be added that the paint is then still in good condition, and on less important bridges would by many engineers be allowed to pass for several years longer. Experience shows, however, that in such cases the metal is liable to be deeply pitted. The paint inside the tubes of the Forth bridge is as perfect as when first applied twelve years ago. The parts of the bridge most subject to rust are near the water, where the underside of the girders get sprayed with salt. The rusting commences on the rivet heads and the edges of the plates. These portions of the bridge are cleaned and repainted every year. The work is in charge of Mr. A. Hunter, who has supplied Mr. Smith with the above particulars.—American Gas Journal.

The Temperature for Burning Portland Cement.

The value of determinations based on laboratory experiments of the stability of materials, and of the treatment with heat for obtaining good Portland cement has been frequently doubted, with the idea that such experiments could not be thoroughly determinative because in the laboratory the masses are burnt under conditions which do not wholly correspond to those of the industrial stock productions. For even when the kiln used for this purpose in the laboratory is an exact model of the industrial kiln, it accomplishes the cooling off of the burnt mass too quickly. If, however, to avoid this, one keeps the fire going longer the burnt mass runs the risk of being vitiated by the rest of the combustibles which are consumed in much greater quantity. Therefore, R. Feret, chief of the laboratory of bridges and causeways at Boulogne-sur-Mer discerns in the law developed by B. Spencer and W. Newbury, of the chemical composition of cement, a weak point, namely, that the two investigators always used for their experiments only a limited quantity of material, about 300 g. In the conclusion of his discussion, however (in the Bulletin de la Societe d'Encouragement, Paris, 1898, p. 867), in the recognition that a large industrial kiln is never used for demonstration in experiments that appear absolutely necessary, he formulates as follows the resquirements for an experimental kiln for the laboratory.

1. It must have a capacity for burning 220 lb. of cement-mass.

2. Its temperature must be controllable within intervals of about 100 degrees, and capable of being raised at least 1,000 degrees and sustained there at will.

3. The heat of the kiln must be at will interchangeably oxidizing or reducing.

4. The burden must have sufficient protection from the influence of the kiln-walls and the fuel-residue. That he has erred greatly as to the hight of the requisite maximum temperature, Feret soon acknowledges and in a postcript (p. 1114) places the minimum at 1,500 degrees. However, he has not contented himself with this correction, but has also fixed nicely the minimum temperature required for burning cement. Thereon he reported in the aforesaid bulletin on page 121, for 1899.

In determining the temperature, he made use of "hard steel", whose composition he unfortunately failed to give. In one of the shaft-furnaces in operation a few years ago in the cement works mentioned, steel bars of various thicknesses and 31.5 in. long were inserted five or six times. Of these no traces were ever found on clearing out the furnace. Of a 31.5-in. steel bar with an .8x.8-in. section, only a pointed end piece with significant signs of the melting remained. Now two steel bars 6 ft. 6 in. long were set up in different places in a Hoffmann kiln, so that they stood erect in the midst of cement bricks, and at a certain distance from the stoke-holes for the coal. Only half the length of each of these bars remained after the burning. Of one bar the lower half remained. It was

straight, but very much swollen, rounded, porous, and very brittle, and looked almost like a piece of lignite. With the exception of the uninjured part, about .1 of an inch thick, along the axis of the bar, the mass was black and shining, and, on chemical analysis, proved to be magnetic iron (Fe_3O_4) which had evidently arisen from the decomposition of the red-hot iron with water-vapor swept along by the draft of the furnace gas.

The other steel bar was bent in several places by the falling in of the surrounding mass of cement; and two pieces of it were found again, of which the longer one had belonged to its upper part and the shorter one to its base. These residues were less swollen than that of the first bar, but corroded on the surfaces. The ends of it extending towards the missing middle part tapered to points, and thereby showed that the piece of bar missing from between them had been melted away. The pretty homogeneous but very heavy mass of cement clinkers (of 3.35 density instead of the normal 3.20) found in the neighborhood of this melted portion contained, moreover, 17.5 per cent of iron oxide; whereas usually the cement produced at the same factory contained only about 2.5 per cent.

An essential condition for the examination, however, is that one makes sure in both cases that the mass of cement clinker about the remnants of the bars were burnt insufficiently before, while those masses where the steel was melted could pass for well burnt. Hence one may conclude that the necessary temperature for burning Portland cement is higher than the melting-point of hard steel and corresponds pretty nearly to that of wrought iron. This, if one takes 1,065 degrees as the melting-point of gold, on the basis of the latest discoveries, will amount to about 1,600 degrees. Therefore, according to Feret's judgment, a good experimental kiln for performing experiments in the manufacture of cement should allow the heat to rise easily to at least 1,800 degrees, so that one can burn pure pastes in it which are free from the fluxes so often met with in the cement business.—Translated from the Thonindustrie-Zeitung for Brick.

On the foregoing experiment, the Thonindustrie-Zeitung comments as follows: "We consider it an utter mistake to try to determine the temperature in cement kilns by laying in steel bars; for every technist should know that steel does not remain steel after it is redhot, either in the oxidizing or the reducing atmosphere. By the change which the steel undergoes its melting-point is also changed. The circumstance, in the experiment cited, that the steel is no longer found is traceable to the fact that, through the reducing atmosphere which most of the time, if not always, reigns in the cement kiln, the steel is changed, by the reception of carbon, to cast iron, which, as is well known, is easily fusible. The experiments made by us to determine the burning temperature for cement gave no higher temperatures than Seger cone 15. We gladly place chills and cones at disposal in case they will fix the temperature in your kilns. Furthermore be it known in this connection that many years ago Herr Director Meyer, in Mahlstatt, made experiments in burning in the gas-furnace of which the Seger-furnace serves as a prototype."

MACHINERY AND TRADE.

Tar Macadam.

A little pamphlet on Tar Macadam Roads has been issued by the National Coal Tar company, No. 100 Williams-st., New York, giving specifications for the pavement, some statement of its utility, and of its success in Hamilton, Ont., and in Providence, R. I., where tar has been used to some extent in the top layers of macadam pavement for several years.

Recent Inventions.

(Reported especially for MUNICIPAL ENGINEERING by Arthur M. Hood, Indianapolis, Ind. Copies of any patent may be obtained for ten cents.

667,445. Feb. 5, 1901. Garbage Furnace or Crematory. Eugene J. Little, Daniel C. Shaw and George H. Breymann, Toledo, Ohio. The refuse is burned upon an elongated grating above which is an arch having trap doors therein, said arch forming the floor of a drying chamber. Two furnaces are formed at one end of the elongated grating, one of the said furnaces discharging over the grate, and the other beneath the grate, and the heated gases from both furnaces pass back through the drying chamber. The material, when dry, is discharged through the trap doors upon the elongated grate.

667,871. Feb. 12, 1901. Fireproof Building Structure. Julian O. Ellinger, Baltimore, Md. A peculiar arrangement of interlaced rods forming the support for concrete partitions or floors.

668,127. Feb. 12, 1901. Water Filter. George F. Hodkinson, Chicago, Ill. A gutter is formed at each side of the filter bed and connecting passages formed between the gutters and bed with a peculiar arrangement of gates for the passages. Mounted above the bed is a traveling agitating means for loosening the material of the bed.

668,232. Feb. 19, 1901. Bridge. Joseph B. Strauss, Chicago, Ill. The counterbalance

of the span is so arranged as to be lowered into the water as the span rises, the resultant effect of the counterbalance being thus varied in accordance with the position of the span.

668,366. Feb. 19, 1901. Fireproof partition. William N. Wight, New York, N. Y. A clamp for partitions consisting of a pair of flexible frames of metal, one lying upon each side of the partition, and a metallic tie conecting the frames and lying between the blocks of which the partition is formed.

668,530. Feb. 19, 1901. Fireproof arch. Samuel Lord, New York. A peculiar interlocking tile having intermediate partitions of such form that the tile may be broken at predetermined points to vary the length of the arch formed by one or more of the tiles.

668,610. Feb. 19, 1901. Automatic drawbridge gate. Victor Johnson, Aurora, Ill. A pair of flexible gates automatically drawn together across the roadway by the movement of the bridge span.

Trade Notes.

ASPHALT.

The Minnesota Asphalt Block company has opened up offices at the Endicott Arcade, St. Paul, Minn., with George M. Cushing as manager. A $50,000 plant will probably be built this spring.

The construction of an asphalt plant, at a cost of $8,000, for the repair of asphalt pavements, is recommended by James H. Meagher, commissioner of public works at Syracuse, N. Y.

CEMENT.

The Kinderhook Portland Cement company, Indianapolis, Ind., has been incorporated to manufacture brick, cement and tiling. Capital stock $2,500, with an authorized capital stock of $300,000. The incorporators are C. A. Kenyon, F. A. Joss and H. G. Branden.

The Nazareth Cement company, Nazareth, Pa., contemplates increasing its plant.

The Lupton Portland Cement company contemplates erecting a $400,000 plant in Lupton, Mich., of 1,200 bbls. daily capacity. The company was incorporated in January under the laws of the state of New Jersey with a capital of $1,250,000. The officers are: President, Geo. T. Stanley, Lupton; vice-president and treasurer, Edward A. Worthington, Chicago; secretary, Walter Higgs, Chicago; assistant secretary, Wm. C. Edgar, Chicago.

The German Alsen Portland Cement company of Hamburg, in addition to its property at West Camp on the Hudson, New York, is reported to have purchased three farms containing valuable and accessible deposits of cement rock and limestone in the Nazareth, Pa., district, the latest being the Charles Mann property, near Nazareth.

The National Portland Cement company, Ltd., has been incorporated at Toronto, Canada, for the purpose of developing the marl deposits near Owen Sound. The directors are: Wm. F. Cowhorn, Jackson, Mich.; P. W. Stanhope, Toronto; Wm. Pinkerton, Toronto; Albert Carman, Stratford, Canada; R. W. McWilliams, Owen Sound.

A tract of land has been purchased in Georgia by Homer W. Cummings, Uriah Cummings and Judge Blydenburg of Stamford, Conn. The land contains fine cement rock and a plant will be erected. A company has been organized and is known as the Chickamauga Cement company.

The Pyramid Cement company, Detroit, Mich., has been incorporated.

BRICK.

The Poston Brick company has been organized at Crawfordsville, Ind., with $50,000 capital. I. C. Elston is president, and Fred Hoffman secretary and treasurer. The company will manufacture paving brick and a patented block.

The stockholders of the old Utica Paving company, which was recently merged into the asphalt combine, will form a new paving brick company and will use vitrified brick instead of asphalt, according to press reports.

George S. Boswell is interested in the company which has been organized at Coffeyville, Kas., to build a vitrified brick plant.

The Brooklyn Brick and Sewer Pipe company of Brooklyn, N. Y., has been incorporated by George D. Beattys, C. Fred Johnson and H. L. Fordham.

MISCELLANEOUS.

A central heating station for three hundred houses is being erected at Washington Court House, O., by the Central Station Heating company of Cincinnati, O. The boiler being erected for this plant is believed to be the largest ever built.

IMPROVEMENT AND CONTRACTING NEWS.

PAVING.

Detroit, Mich.—Corporation Counsel Tarsney began suit Feb. 13th to recover from the Detroit railway the sum of $23,000 for paving between the tracks when the road was being built.

New Orleans, La.—About 22,000 sq. yds. of Schillinger pavement and 4,500 cu. yds. of concrete between the tracks of several electric car companies on Canal-st., is being constructed by John McCoy of this city.

CONTEMPLATED WORK.

Iola, Kas.—Paving is contemplated.

Hamilton, O.—Macadam paving is favored for Dayton-st.

Macon, Ga.—Asphalt paving is recommended by the street committee.

Owatonna, Minn.—The question of street paving is being considered.

Hancock, Mich.—Asphalt paving is contemplated for Quincy-st. Village board.

Lafayette, Ala.—This town proposes to improve its streets this year.

West Duluth, Minn.—A petition is being circulated for paving Central-ave.

Athens, Ga.—The macadamizing of Milledge-ave. is contemplated this summer.

Chicago, Ill.—The transformation of Lake-ave. into a boulevard is contemplated.

Bridgeport, Conn.—The purchase of a new road roller is contemplated by the council.

Atlanta, Ga.—Capitol-ave., between E. Fair and Bars-sts., will be paved with asphalt.

Buffalo, N. Y.—Morgan-st., between Niagara and Genesee-sts., will be paved with asphalt.

Tiffin, O.—Plans have been submitted for paving a portion of Genesee-ave. and Hancock-st.

Patchogue (L. I.), N. Y.—The question of building a short road will be voted on in March.

Dover, N. H.—The sum of $17,000 has been appropriated for highways, and $2,000 for sidewalks.

Montgomery, Ala.—A bill has been passed in the legislature authorizing the issue of bonds for paving.

Milford, Mass.—The question of paving Main-st. is being considered. M. E. Nelligan, supt. sts.

East Orange, N. J.—Ordinances have been passed for the improvement of 1,700 ft. of Tremont-ave.

West Hoboken, N. J.—An ordinance has been passed for improving Newkirk-st. Chas. Dietz, chmn. com.

Akron, O.—A resolution has been passed to pave Grant-st., from Exchange to South, with brick or asphalt.

Portsmouth, O.—(Special)—W. H. W. Jenkins says a petition is being circulated for paving Findley-st. with brick.

Owatonna, Minn.—The estimated cost of the proposed brick or asphalt paving on Cedar-st. is $1.65 a sq. yd.

Lima, O.—Paving has been recommended for portions of W. High, Cole and Buckeye-sts. and Bruce and Rice-aves.

Pontiac, Ill.—About 30,000 sq. yds. of brick paving will be constructed this summer. P. C. Knight, engr.

Pittsfield, Mass.—Plans and estimates are being made for paving West and North-sts. A. A. Forbes, engr. B. P. W.

Woodbury, N. J.—Plans for improving Delaware and German-sts. have been approved by State Commissioner Budd.

Ft. Dodge, Ia.—Paving is contemplated for Sixth, Seventh, Eighth and Ninth-sts., from Central-ave. to First-ave. N.

Baltimore, Md.—The county commissioners contemplate the purchase of a stone crushing plant for the Fourth district.

Barberton, O.—The city engineer was directed, Feb. 11, to prepare plans and specifications for paving Second-st. with brick.

West Bay City, Mich.—A large amount of asphalt paving is contemplated for this spring, according to the local press reports.

Plainfield, N. J.—The paving of Prospect-ave., from Park to Woodland-aves., 100 ft. wide and 1 mile long, is contemplated.

Sumter, S. C.—Bids are desired for furnishing and laying 10,000 to 20,000 square yards of macadam roadway. C. M. Hurst, jr., city clerk.

Waco, Texas—Asphalt or vitrified brick paving is contemplated for Austin-ave., and the cross streets from Third to Eighth.

Eau Claire, Wis.—Ordinances have been adopted providing for brick paving in Eau Claire, Gibson and Barrow-sts., and Grand-ave.

Davenport, Ia.—(Special)—F. Heinz, mayor, says bids will be asked in the next sixty or ninety days for about twenty-five blocks of brick paving.

Cohoes, N. Y.—City Engineer Hayes has been directed to prepare plans and specifications for paving Newcome and Short Main-sts.

Champaign, Ill.—Plans for the proposed paving in Chestnut-st., from Main-st. to University-ave., are being made by City Engineer Tarrant.

New Haven, Conn.—The board of aldermen have decided to pave Temple, Elm and Olive-sts. and Howard-ave. with brick. C. W. Kelly, city engineer.

Albany, N. Y.—The question of resurfacing the block pavement on S. Pearl-st., to Gansevoort-st., with asphalt, is being considered.

New Orleans, La.—New specifications will be prepared by the city engineer for paving Jefferson-st., from Charles to Decatur, with asphalt.

Cambridge, Mass.—About 9,000 square yards of brick pavement will be constructed on Massachusetts-ave. by day labor. C. A. Brown, superintendent of streets.

Macomb, Ill.—(Special)—City Engineer Holmes says that bids may be asked about May 1, for 24,000 square yards of double course brick paving.

St. Louis, Mo.—The city council passed twenty ordinances Feb. 8, for reconstructing streets in the down town district. Robert E. McMath, prest. B. P. I.

San Francisco, Cal.—Asphalt paving on 6-inch concrete has been recommended by the board of public works for Pine-st., from Sansome to Battery.

Spartanburg, S. C.—This city voted $50,000 for street paving, which work will begin as soon as an engineer can be engaged and plans prepared.

Aurora, Ill.—A petition is being circulated asking for asphalt paving with combination cement curb and gutter on Fox-st., from La Salle to State.

Rock Island, Ill.—The property-owners on Twenty-first-st. have petitioned for brick paving. The council was originally asked to pave the street with asphalt.

Toronto, O.—Asphalt paving is recommended for Metcalf-st., and brick paving for Huron and Lombard-sts., in the annual report of the city engineer.

Utica, N. Y.—Resolutions have been introduced providing for paving Roberts, Cornelia, Seneca, State, Washington and York-sts., and Lincoln-ave.

Peoria, Ill.—Plans are being discussed, according to local press reports, which involve a system of paving on the West Bluff which will include fifty-four blocks.

Rochester, N. Y.—Mayor Carnahan will veto the ordinance providing for asphalt paving on Julia-st., and approve one for macadam, according to press reports.

Chelsea, Mass.—An ordinance has been passed appropriating $10,000 for paving Washington-ave. with brick, and $3,500 for the purchase of a road roller.

Birmingham, Ala.—An ordinance has been passed to pave the walks on portions of Lawn-st. and Alta-ave. with brick, with 6-inch granite curbing. W. M. Drennen, mayor.

Newport, Ky. (Special)—W. L. Glazier, supt. pub. wks., says 5,000 lin. ft. of macadam paving, averaging 40 ft. in width, with cement curb and gutter, is contemplated.

Lawrence, Kas.—Resolutions are pending for paving Winthrop-st., from Mississippi to Massachusetts, and Pinckney-st., from Indiana to Massachusetts-ave.

Bay City, Mich.—The city engineer was directed, Feb. 11, to prepare estimates for the proposed brick and asphalt paving on Henry, Midland and Washington-sts. Mayor Lind.

Springfield, O.—A resolution has been adopted to pave Columbia-st., from Fountain-ave. to Limestone-st., with vitrified paving brick or block. R. N. Lantz, cy clk.

Syracuse, N. Y.—Plans and specifications have been approved for paving portions of Gifford to Jefferson, W. Fayette, Canal, Pearl, Harrison, Walton and other streets and avenues.

Cohoes, N. Y.—The city engineer has been directed to prepare plans for paving Broadway, Johnston and Younglove-aves., and Grant, Saratoga, Ontario, Newark, Lancaster, George, Schuyler and Seneca-sts.

St. Paul, Minn.—The board of public works has vetoed the resolution for paving Rice-st., from College-ave. to Front-st., with brick, and has passed an ordinance for asphalt paving for the street.

Pawtucket, R. I.—Granite block paving on a concrete foundation is recommended for Pawtucket-ave., in the annual report of the board of public works. Wm. A. Barclay, com. B. P. W.; Geo. A. Carpenter, cy. engr.

Michigan City, Ind.—(Special)—H. M. Miles, cy. engr., has been instructed to prepare plans and specifications for 35,000 sq. yds. of vitrified brick paving on Second, Market, W. Boston, S. Franklin and Michigan-sts.

Indianapolis, Ind.—The street improvements planned for this year include portions of 35 streets. The property-owners in Meridian-st., north of Fall creek, have petitioned for asphalt paving instead of wooden block as proposed.

Seattle, Wash.—The board of public works has approved estimates for brick paving on Jackson-st., Yesler-way, Third and First-aves. S., at a cost of $102,000 and proposed improvement of Madison-st., at $38,580. Cy. Engr. Thomson.

Buffalo, N. Y.—The residents on East-st., between Hertle-ave. and Paris-st., have petitioned for paving. The board of public works has decided upon amendments to the asphalt paving specifications cutting the guarantee term down to ten years instead of fifteen years.

Norwich, N. Y.—Petitions have been filed with the trustees asking for macadam paving on Silver-st., between E. Main and Rexford, and Broad-st., between Pleasant and Henry and American lane and Division-sts., and for brick for the business portion of Broad-st., between Henry-st. and American lane.

Petaluma, Cal.—(Special)—N. S. Frost, cy. engr., says that the board of trustees has passed resolutions for 2,000 lin. ft. of macadam paving on Western-ave., 600 lin. ft. of grading in Howard-st., 160 lin. ft. of graveling and macadam paving in Kentucky-st., and 2,100 lin. ft. of grading, curbing, guttering and macadam paving on Main-st.

Detroit, Mich.—The board of works estimates that $1,215,005 will be needed this year for paving and repaving, an increase of $312,928 over last year. Asphalt paving is desired for a number of suburban streets, including Cass, Garfield, John R. and Willis-sts., and brick is proposed for Amsterdam, Bates, Dix, Fort, Farmer, Plum, Russell, Warren and other streets.

Los Angeles, Cal.—Specifications are being prepared by City Engineer Stafford for paving that will admit of the use of home product. The general specifications as they are at present call for the use of "natural" California asphalt, and only one company can bid under these provisions, as it controls all the mines that produce that material. The new specifications will remove the restriction upon free competition.

CONTRACTS TO BE LET.

Marion, Ia.—Sealed bids are asked until March 4 for macadam paving on Seventh-ave. R. Richmond, cy. clk.

North Baltimore, O.—Bids are asked until March 4 for paving Main-st. with brick. J. Radebaugh, vil. clk.

Greenville, O.—Bids are asked until March 18 for block asphalt paving on Washington-ave. C. E. Caldenood, cy. clk.

Riverside, N. J.—Bids are asked until March 11 for macadamizing about four miles of streets. J. H. Norton, boro. clk.

Denison, Ia.—Bids are asked until March 4 for public roads in East Boyer township during 1901. A. C. Lochmiller, clk. bd.

Rome, N. Y.—Bids are asked until March 12 for brick or asphalt paving on N. Washington, N. George and Dominick-sts. G. E. Schillner, cy. engr.

Bedford, Ind.—Sealed bids are asked until March 4 for building gravel or macadam roads in Shawswick township. John M. Gainey, co. audt.

Collinwood, O.—Sealed bids will be received until March 11 for draining, grading and slagging E. Collamer-st. L. A. Wilson, vil. clk.

Cincinnati, O.—Sealed bids are asked until March 6 for paving McKean alley, from Baymiller-st. to Harold alley, with brick. Robt. Allison, pres. B. P. S.

Jacksonville, Fla.—Sealed proposals are asked until March 28 for 13,195 yds. of vitrified brick paving on portions of six streets. Philip Priolean, cy. engr.

Cincinnati, O.—Sealed bids are asked until March 2 for improving Summit-ave., from Edgewood-ave. to Reading road, Springfield township. Eugene L. Lewis, co. audt.

Alexandria, La.—The bids received Feb. 18 for brick paving on Second-st. were rejected and new bids will be received about March 10. Board of Improv. Comrs.

Annapolis, Md.—Sealed bids are asked until March 8 for paving Maine-st. with vitrified paving brick and asphalt block. H. M. Redd, cy. engr.; R. H. Lansing, Jr., cy. clk.

Marinette, Wis.—Sealed bids are asked until March 5 for about 3,785 sq. yds. of nine-inch macadam paving, 2,000 lin. ft. stone curbing and 1,300 cu. yds. excavation. A. L. Hillis, cy. engr.

Marion, O.—Sealed bids are asked until March 16 for paving as follows: Greenwood-ave., 6,805 sq. yds. brick or block paving; 1,960 cu. yds. grading; 6,805 sq. yds. Portland cement or patent ground filler. N. Prospect-st., 6,210 sq. yds. brick, block or

sheet asphalt paving; 6,210 sq. yds. patent grout or Portland cement filler. Jas. J. Beatty, cy. clk.

Leavenworth, Kas.—(Special)—Sealed bids are asked until March 4 for 23,000 sq. yds. of vitrified paving brick on 6-in. concrete base on Tennessee-st., from Henry to Ontario. Holland Wheeler, cy. engr.

Toledo, O.—Sealed bids are asked until March 4 and 18 for paving certain streets with vitrified paving brick or block, asphalt blocks, Kreodone creosoted blocks or sheet asphalt. J. E. Connel, cy. clk.

Des Moines, Ia.—Sealed bids are asked until March 5 for 3,362 sq. yds. of brick paving and six-inch concrete base on Mary-ave. and Second and Depot-sts. G. A. Eberhart, J. E. Stout, B. P. W.

Atlantic City, N. J.—Sealed bids are asked until March 6 for constructing 12 mls. of gravel road from May's Landing to Pleasantville. John T. Irving, dir., Elwood, N. J.; J. J. Albertson, engr., Magnolia, N. J.

St. Louis, Mo.—Bids are asked until March 4 for repairing the government roadway, from Cache river bridge, in Pulaski county, Illinois, to the graded roadway extending from Mound City, Ill., to National cemetery, near that city. D. D. Wheeler.

Havana, Cuba.—Bids will be opened for street paving April 3. Bidders must deposit $500,000 with their bids, and the successful bidder will be required to give $1,000,000 security, in cash or bonds, besides paying the Cuban government $250,000 on account of the extinguished rights of M. J. Dady, W. J. Borden, U. S. engineers, chief engineer of city; Alexandro Rodriguez, mayor.

Waukesha, Wis.—Sealed bids are invited until March 2 for paving West-ave., from Dunbar-ave. to Main-st., as follows: Exc., 2,100 cu. yds.; setting combination curb and gutter, 3,000 lin. ft.; macadam paving, 6,150 sq. yds.; cast-iron gutters, 33 lin. ft.; brick gutters and walks, 38 sq. yds.; gutter bridges, 16 lin. ft.; catch basins and gutters. John P. Day, chmn. B. P. W.

Garrett, Ind.—Sealed bids are asked until March 5 for paving Randolph-st., from the north to the south corporation limits, 27,000 sq. yds., with paving brick. The work will include 11,000 cu. yds. of excavation; 9,200 lin. ft. 4x20 straight curb; 1,200 lin. ft. 3x15 marginal curb; 960 lin. ft. 4x20 radial curb; 36 new street inlets; 2 new manholes; 8 old manholes, tops to be adjusted; 6,175 sq. ft. new cement walk and gutter. T. J. Loar, cy. clk.; J. J. Van Auken, engr., Auburn, Ind.

CONTRACTS AWARDED.

Buffalo, N. Y.—The contract for improving Tifft-st. was awarded to Henry P. Burgard for $9,750.

Atchison, Kas.—The contract for grading, curbing and paving Fifth-st. was awarded to Wines & Co. for $3,431.71.

Anderson, Ind.—C. J. Miller & Co. of Seymour secured the contract for constructing seven sections of gravel road in Stony Creek twp. for $23,359.

Indiana, Pa.—The contract for constructing three miles of highway in West Wheatfield twp. was awarded to R. A. Reighard of Johnstown, Pa., for $8,995.

San Francisco, Cal.—The City Street Improvement company was awarded the contract for paving Sacramento, Clay and Washington-sts., between Montgomery and Sansome, with asphalt on 6 in. concrete base for $5,790.12.

Toledo, O.—Contracts have been awarded to C. H. Burchenal for asphalt block paving as follows: Greenwood-ave., from Miami to Yondota, $5,241.04; Stratton-st., from Miami to Yondota, $6,828.49; Yondota-st., from Nevada to Greenwood-ave., $6,550.19.

St. Paul, Minn.—Fielding & Shepley secured paving contracts as follows: Wabash-st., from College to University, sandstone, $18,490 for city's portion and $14,272 for street railway's share. W. Seventh-st., from Third to Ramsey, sandstone block, $13,800 and $8,300.

Niagara Falls, N. Y.—(Special)—F. J. Sullivan, cy. clk., says paving contracts were awarded Feb. 7 as follows: Buffalo-ave., from Portage-road to Twenty-fourth-st., asphalt, Barber Asphalt Paving company, $35,-170; Buffalo-ave., from Twenty-fourth-st. to Sugar-st., asphalt, Henry Burgard, $34,475.50.

Chicago, Ill.—Contracts for cement walks along various streets have been awarded to the Sennott Construction company, 84 Washington-st.; Thomas J. Burke & Co., 115 Monroe-st.; Perkins Const. company, Builders' and Traders' Exchange Bldg.; John A. McGarry & Co.

Marion, Ind.—(Special)—The contract for paving Homeward-boulevard with asphalt was awarded Feb. 20 to the R. F. Conway company of Chicago as follows: Asphalt paving, 34,334 sq. yds., $1.93 a sq. yd.; Berea curb, 5x24, 19,088 lin. ft., 45 cents; limestone curb, 4x18, 1,582 lin. ft., 35 cts.; masonry, 1,198 cu. yds., $7.50; bridge, $12.450; iron pipe, 540 lin. ft., $3.40; masonry, 42 cu. yds., $4.50; a 10-inch sewer pipe, 225 lin. ft., 50 cents; 19 curb inlets and basins, $15; total, $99,162.82.

Columbus, O.—Bids for resurfacing Broad-st., from Taylor to Woodlawn-ave., were received Feb. 12 as follows: American Asphalt company, Trinidad binder course, $1.40 for 1 in. and $1.45 for 2 in. wearing surface; total, $12,243; Barber Asphalt Paving company, $1.55 for 1 in. binder course and 2 ins. wearing surface, total, $12,344; Cleveland Trinidad Paving company, $1.42 for 1 in. binder course and 2 ins. asphalt; A. G. Pugh, $1.52 for Trinidad pitch or land or Bermudez asphalt, and $1.60 for Kentucky rock asphalt; Shaffer Roofing company, $1.53½ for Kentucky rock asphalt.

SEWERS.

Galveston, Tex.—The board of aldermen passed a resolution Feb. 4 over Mayor Jones's veto to appropriate $93,600 to take over the sewer plant of the Galveston Sewer company.

CONTEMPLATED WORK.

Easthampton, Mass.—Plans are being prepared for improvement of the sewerage system.

Fremont, O.—Bids will be asked soon for sewers in Front, Tiffin and South-sts.

Rehoboth, Md.—Plans for a sewerage system have been adopted by the town commissioners.

Macomb, Ill.—(Special.)—City Engineer Holmes says about one and one-half miles of 15 in. sewers are contemplated.

Bound Brook, N. J.—An ordinance has been passed for a lateral sewer on Second-

st. Engineer Doughty.

Sacramento, Cal.—Plans for a sewage pumping plant have been received according to press reports.

East Hampton, Mass.—The question of extending the outlet of the sewerage system is being considered.

Wakefield, Mass.—Plans for the proposed sewerage system have been approved by the state board of health.

Barberton, O.—An ordinance has been adopted for a system of storm sewers for district No. 1. Mayor McNamara.

Great Falls, Mont.—The sum of $25,000 has been appropriated for the extension of the Sixth-st. sewer.

Davenport, Ia.—The estimated cost of building the First district or East Davenport sewer is $20,115.

Danville, Ky.—Plans for a sewerage system are being made by Alvord & Shields of Chicago. J. B. Fisher, mayor.

Cohoes, N. Y.—Plans and specifications have been prepared for the sewers for the fourth section. Engr. Hayes.

Columbia, S. C.—(Special.)—D. B. Miller, cy. engr., says a sewerage system is contemplated for the entire city.

Kamloops, B. C.—The council has been requested to engage an engineer to prepare plans for a sewerage system.

Brockton, Mass.—The legislature has authorized the city to issue $100,000 bonds for additional sewer construction.

Taunton, Mass.—The board of aldermen are considering the question of appropriating $100,000 for sewer extensions.

Manchester, N. H.—The board of street commissioners have asked for an appropriation of $20,000 for building new sewers.

The question of issuing bonds for sewerage systems will be voted on as follows: Madison, Ill., April; Mt. Sterling, Ky.

Longmont, Col.—The citizens have requested the city council to make a preliminary survey at once for a sewerage system.

Iola, Kas.—Plans are being prepared for a sewerage system by Burns & McDonnell, of Kansas City, Mo. W. M. Knoff, cy. clk.

Williamsburg, Va.—T. Chalkley Hatton, C. E., Wilmington, Del., estimated the cost of building additions to sewerage and water works systems for this place at $30,000.

Petaluma, Cal. (Special)—N. S. Frost, cy. engr., says he has submitted plans for 11,000 feet of 6 in. sewers in various streets in the southeastern part of town.

Newport, Ky.—(Special)—W. L. Glazier, supt. pub. wrks., says 15,000 ft. of 2½ to 3½ feet brick or concrete main sewers, and 8 to 24 in. lateral sewers are contemplated.

Baltimore, Md.—Mayor Hayes will present a bill to the legislature providing for a sewerage system for this city. If passed the question will be voted on May 7.

New York City.—A resolution has been adopted by the board of public improvements to build a main sewer and disposal plant for Rockaway, at a cost of $300,000.

Hamilton, Ohio.—Ordinances have been passed for a storm sewer in Court and other streets and a sanitary sewer and house connections in a number of streets. M. O. Burns, cy. clk.

Wawatosa, Wis.—The state board of health approved Feb. 9th the plans and specifications prepared by John W. Alvord of Chicago, for a sewerage system and disposal plant. E. D. Hoyt, mayor.

Kankakee, Ills.—The estimated cost of the proposed sewerage system from a point near Chestnut-st. and Greenwood-ave. to the river, nearly a mile, is $19,500. Cy. Engr. Gregg.

Bozeman, Mont.—The city council has ordered the construction of a sewer which requires considerable cement. S. H. Crooks, Livingston, Mont., is making plans. W. S. Davidson, chmn. sewer com.

Sacramento, Cal.—The Sacramento council of federated trades favors the construction of a sewerage system, pure water and a system of water mains, a city hall and a modern high school building.

Pawtucket, R. I.—The purchase of at least four new catch-basin carts is recommended in the annual report of the board of public works. Wm. A. Barclay, comm'r. P. W. Geo. A. Carpenter, cy. engr.

Kingston, N. Y.—A plan of sewerage and drainage for the upper part of the city has been adopted. The plan embraces more than 25 miles of pipe sewers and purification plant for house sewage. Geo. N. Bell, cy. engr.

Columbus, O.—Rudolph Hering has been engaged to review all the work done heretofore regarding the sewerage and sewage disposal systems and report on the general problem and the nature and the cost of the works needed.

Attleboro, Mass.—Plans for a sewerage system and sewage disposal by intermittent filtration have been prepared by Snow & Barbour of Boston. The sewerage committee will report in March. E. S. Hooten, chmn. com.

The question of building sewerage systems is being urged at the following places: Indianola, Ia.; Pleasant, Cal.; Oswego Falls, N. Y.; Culpeper, Va.; Sumter, S. C.; Brockport, N. Y.; Opelika, Ala.; Webster, Mass.; Arlington, Mass.; New Canaan, Conn.; Oneonta, N. Y.; Gilman, Ill

Columbus, Ga.—(Special)—R. S. Johnson, supt. pub. wrks., says the city council passed resolutions Feb. 6 providing for an election to be held May 9 to vote on the question of using $125,000 bonds for the purpose of beginning the construction of a system of sanitary sewers.

Cleveland, O.—Plans for the outlet section of the intercepting sewerage system for the East Side has been approved by the board of control. This section extends from Manhattan beach to a point between Collinwood and Glenville, and will be 13 feet in diameter. The estimated cost is $320,000.

CONTRACTS TO BE LET.

Oklahoma City, Ok. T.—Bids are asked until March 4 for 15,000 ft. of pipe sewers. Cy. Comm.

Standing Rock, N. D.—Bids are asked until March 5 for a sewerage system. W. A. Jones, comr. Indian affairs, Washington, D. C.

Havana, Cuba—Bids will be opened April 3 for sewerage. W. J. Borden, U. S. engrs., ch. engr, of city; Alexandro Rodriguez, mayor.

Cleveland, O.—Sealed bids are asked until March 5 for sewers in Pearl and Petrie-sts. and Rhodes-ave. Walter P. Rice, dir. pub. wrks.

Canton, O.—Sealed bids are asked until March 9 to furnish all street and sewer castings needed by the city for one year. Louis N. Ley, cy. clk.

Hackensack, N. J.—Sealed bids are asked until March 4 for 1,480 feet of 18, 15, 12-in. pipe sewers. Wm. E. Clarendon, pres. Hackensack Improvement Comm.

Chillicothe, O.—Sealed bids are asked until March 8 for 2,300 ft. of 24-in. storm sewer in Sugar-st. and 6, 8, 15-in. sanitary sewers in certain streets. R. H. Lansing, Jr., cy. clk.

CONTRACTS AWARDED.

Suffolk, Va.—The contract for a sewerage system was awarded to Guild & Co., of Chattanooga, Tenn.

Allegheny, Pa.—The contract for a sewer in Evergreen road was awarded Feb. 12 to Thomas Prosser for $8,205.

Bay City, Mich.—Henry McCauley was awarded a contract Feb. 11 for a sewer in N. Park-ave., for $1,647.75.

Long Island City, N. Y.—Bids were received Feb. 20 for sewers in Webster and Paynton-aves., and William-st., from nine firms.

Glenville, O.—The W. P. Rice engineering company secured the contract for building the South End sewers for $16,564.68.

Union, S. C.—The contract for building a sewerage system was awarded to George O. Tenney of Spartanburg, for $21,222.

Warsaw, Ind.—The contract for constructing three lateral sewers was awarded Jan. 29, to E. Woods of Decatur, Ind., for $11,790.90.

Madison, Wis.—The contract for constructing septic tanks for the sewage disposal system has been awarded to J. P. Blake of Dubuque, Ia., for $7,020.

Plainfield, N. J.—Bids received Feb. 18 for improving the sewage disposal works, bids and appurtenances, from ten contractors. The contract has not been awarded.

Greenwich, Conn.—Bids were received Feb. 11 for building two miles of pipe sewers from thirteen contractors, the lowest being that of Daniel M. Rossen, Kingstown, Pa., $15,323.

Hartford, Conn.—The contract for a sewer in Smith-st., was awarded to C. H. Slocomb for $1,377.55. He also secured the contract, Feb. 13, for building sewers in Pope park for $4,586.33.

Syracuse, N. Y.—The contract for building the Ninth ward trunk sewer was awarded Feb. 11 to T. J. Baker, for $15,073.25 for web tile. Samuel Brown secured the contract for a 12-in. pipe sewer in Judson-st. for $440.43.

New York City, N. Y.—The lowest bids submitted Feb. 13 for sewers in the borough of Bronx were as follows: E. 189th-st., Thomas Kelly, High Bridge, N. Y., $9,158; Woodlawn Road, M. J. Leehy, 990 E. 156th-st., $11,010.

Petaluma, Cal.—(Special)—N. S. Frost, cy. engr., says that contract was awarded Feb. 18 for the Oak-st. sewer as follows: 262 lin. ft., 18-in. pipe, 97c per lin. ft.; one manhole, $24.50; 400 lin. ft., 18-in. pipe sewer, 93c.

WATER-WORKS.

Bills will be introduced in the Wisconsin legislature asking for the protection of public water supplies and for a state laboratory.

Seneca Falls, N. Y.—The Seneca Falls water works plant was sold at receiver's sale Feb. 17 to Payson Bros. of Maine, who held a mortgage of $60,000.

The New Jersey legislature has three water pollution bills before it. One authorizes the present state sewerage commission to organize a sewerage district and build sewage disposal works whenever municipalities, which it has notified to stop polluting the water of the state, have allowed half of the time limit to pass without taking action. A second bill provides for the creation of sewerage districts and the appointment of commissioners to relieve the streams of the state from pollution. This bill describes how the work should be done and the necessary money raised. Plans adopted by such district commissioners would be subject to approval by the state sewerage commissioners. The district commissioners would be appointed by the governor. The third bill incorporates the Lower Passaic sewerage and drainage district, comprising all those portions of Passaic, Bangor, Hudson and Essex counties which drain into the Passaic river below the Great Falls at Paterson.

CONTEMPLATED WORK.

Granite Falls, Minn.—The extension of the water mains is proposed.

Mitchell, S. D.—The enlargement of the water works system is contemplated.

Sault Ste. Marie, Mich.—The construction of an aqueduct water works system is urged.

Norfolk, Va.—A meter system is recommended by W. F. Brookes, cy. engr., in his annual report.

Geneva, Ohio.—Bids will probably be asked in March for a system of water works.

Cherryvale, Kans.—Plans and specifications have been adopted for a municipal water works plant.

Streator, Ill.—The Streator Aqueduct company contemplates putting in an addition to its filter plant this summer.

Salida, Col.—The city council voted to issue $24,000 bonds for the improvement and extension of the water works.

Cincinnati, Ohio.—Surveys for a water works system will be made soon. C. F. Musson, of Norwich, N. Y.

Columbus, Ind., (Special)—Levi Hege, cy. engr., says a 5,000,000 gal. pumping engine will be purchased this summer.

Ann Arbor, Mich.—A bill will be introduced in the legislature asking for authority to build a municipal water works system.

Osawatomie, Kans.—Plans and specifications will be made by Burns & McDonnell of Kansas City, Mo. H. S. Maynard, mayor.

St. Louis, Mo.—An ordinance is being prepared preparatory to the construction of a filtration plant for the World's Fair grounds.

Port Huron, Mich.—The Port Huron water board will recommend the purchase of a large engine for the pumping station on St. Clair river.

Newport, Ky. (Special)—W. L. Glazier, supt. pub. wrks., says about 3,000 or 4,000 feet of six to ten-inch water mains extension is proposed.

Shenandoah, Pa.—The employment of an engineer has been authorized to determine

the best method for increasing the water supply. Water comm.

Sharpsburg, Pa.—The question of issuing $25,000 bonds for repairing and improving the water works and electric light plants is contemplated.

The question of issuing bonds for the construction of water works systems will be voted on at the following places: Ruthton, Minn.; Clara City, Minn.

Bills have been passed in the legislatures authorizing the construction of water works at the following places: Sunapee, N. H.; Clayton, Ala.; Decatur, Ala.

Monon, Ind.—The water commissioners have asked for permision to enlarge and better equip the water works system, at a cost of about $20,000.

Fort Collins, Colo.—A committee has been appointed to report on estimates and recommendations for the extension of water mains. T. H. Garrett, cy. clk., William Rist, cy. engr.

Pawtucket, R. I.—John H. Walker, chf. engr., recommends the construction of a filter in the yard at No. 2 station. William Barkley, com'r. bd. pub. wrks. George A. Carpenter, cy. engr.

Municipal ownership of water works is proposed at the following places: Grayville, Ill.; Vicksburg, Miss.; Waco, Texas; Canisteo, N. Y.; Racine, Wis.; Ocean Springs, Miss.

Wellsville, O.—A new pumping station, two 3,000,000 gal. pumping engines, new 16-in. force mains to reservoirs, and 14-in. distributing main, is contemplated. D. A. Davidson, supt. water works.

Minneapolis, Minn.—The legislative com- for the water works. Petitions have been received from about eight miles of water mains.

The question of issuing water bonds has been favorably voted on at the following places: Amherst, Wis.; Ft. Atkinson, Wis.; Rockwood, Tenn.; Hooper, Neb.; Wickliffe, Tenn.; Walhalla, N. D.; Tannersville, N. Y.

Boston, Mass.—The Metropolitan water board will begin this spring the construction of a new 300,000,000 gallon aqueduct, 13.4 miles long and extending from the Sudbury reservoir in Southborough, toward the Metropolitan water district.

California, O.—R. M. Quigley & Co. of St. Louis, Mo., desire to sublet certain work in the construction of the reservoir for the Cincinnati water works. The works include sandstone and brick masonry, paving, cement and concrete work. etc.

Lynn, Mass.—The water board voted to petition the city council to authorize the mayor to petition the legislature for permission to borrow $400,000 outside its debt limit for the purpose of developing the local water system by the creation of reservoirs.

Ft. Smith, O.—(Special)—W. H. H. Jenkins says the water works trustees are discussing the advisability of building a reservoir for supplying this city with water instead of direct pressure, as at present. A committee has been appointed to collect data and make recommendations regarding a reservoir or a good filtering plant as the best plan from a sanitary point of view.

The construction of water works systems is contemplated at the following places: Mt. Ayr, Ia.; Ewing, Neb.; Spencer, Ind.; Swedesboro, Pa.; Bessemer, Ala.; Langdon, N. D.; Silver Lake, Minn.; Wymore, Neb.; Mt. Sterling, Ill.; Webster, S. D.; Wier City, Kas.; Elk Point, S. D.; Kiester, Minn.; Flora, Ill.; Abingdon, Ill.; Newburn, Tenn.; Rankin, Ill.; Egan, S. D.; Piqua, O.; Earlville, Ia.; Fowler, Col.; Ocean City, Md.; Waterford, Pa.; Phillippi, W. Va.; Marion, Ky.; Whitney Point, N. Y.

CONTRACTS TO BE LET.

Dover, N. J.—Bids are asked until March 14 for driving a test well.

Syracuse, N. Y.—Bids are asked until March 10 for building water works. A. G. Carlson, engr.

Auburn, N. Y.—Bids will be received until March 2 for furnishing a 10,000,000-gal. horizontal pump. Water bd.

Ottumwa, Ia.—Bids are asked until March 18, postponed from Feb. 11, for a water works system. E. Hogland, chmn. water comm.

Standing Rock, S. D.—Bids are asked until March 6 for a water works system. W. A. Jones, comr. Indian affairs, Washington, D. C.

Detroit, Mich.—Bids are asked until March 4 for the superstructure of an addition to the pumping station at Water Works Park. Benj. F. Guiney, secy. bd. water comm.

Dassel, Minn.—Bids are asked until March 6 for constructing and erecting a 100-ft. steel water tower, with tank, gasoline engine, engine house, mains, hydrants, etc. J. W. Norgren, rec.

Kenosha, Wis.—Bids will be received until April 2 for a 4,000,000-gal. vertical cross compound pumping engine, with necessary piping and accessories. Bidders must furnish plans and specifications. Water comr.

Cincinnati, O.—Sealed bids are asked until March 5 for furnishing water valves, sluice gates and mud valves for the settling reservoirs and for the pump mains from the Eastern pumping station, near California. Aug. Herrmann, pres. bd. trustees w. w. comrs.

Chicago, Ill—Sealed bids are asked until March 16 for furnishing cast iron rings and covers for hydrant chambers, cast iron water pipe, cast iron valve basin covers, special castings, hydrant and stop valve castings, etc. L. E. McGann, comr. pub. wrks.

New York City, N. Y.—Bids are asked until March 7 for furnishing hydrant catches and rollers, tapping cocks, etc., for boroughs of Manhattan and Bronx; furnishing and erecting two boilers and appurtenances, and for the removal of four old boilers at Prospect Pumping Station, Borough of Brooklyn. William Dalton, comr. water sup.

CONTRACTS AWARDED.

Menasha, Wis.—A franchise has been granted to J. P. Miller & Co. of Chicago for a water works and an electric light plant.

Rochester, N. Y.—The contract for furnishing 835 water meters was awarded to the Hersey Meter company of Boston for $5,770.85.

Cape May, N. J.—The contract for extending the water supply system was awarded Feb. 9 to Edward W. Cresse for $9,640.

Woodstock, Va.—G. L. McKain of Salem, W. Va., was awarded the contract Feb. 14 for a water works system for $18,200.

Petersburg, Ind.—The contract for a municipal water works system was awarded Feb. 20 to Frank Schefold of New Albany for $28,000.

Dallas, Tex.—The contract for a new storage reservoir has been awarded to Dan Morgan of this city for $41,000. Other contracts were awarded to Abendroth & Root of New York City and the Dimmock Pipe company of Birmingham, Ala.

Philadelphia, Pa.—The contract for a filter plant at Roxborough has been awarded to Daniel J. McNichol for $229,083, according to press reports. He also received the contract for supplying and laying water pipe, furnishing stop cocks, stop boxes, etc., for $669,633.

BRIDGES.

New Hope, Ala.—A steel drawbridge across Paint Rock river is contemplated.

Gonzales, Tex.—Bids are asked until March 4 for building three steel bridges.

Joplin, Mo.—Bids will be asked soon for the Lone Elm bridge across Turkey creek.

Waukesha, Wis.—Plans for a bridge at Locust-st. have been adopted by the council

Wabash, Ind.—Bids are asked until April 1 for building five county bridges. B. F. Cirmans, co. audt.

Pittsburg, Pa.—A new bridge will be built this spring to replace the present structure at Lincoln-ave.

Topeka, Kas.—A bill has passed the senate authorizing Shawnee county to build four bridges across Kansas river.

Princeton, Ind.—Bids are asked until March 6 for 18 iron county bridges. Jonathan W. Phillips, chmn. bd. co. com's:

Devils Lake, N. D—The citizens of this place have subscribed $7,000 for the construction of a bridge across the lake

Pekin, Ill.—The commissioners of Dillon twp. contemplate building a bridge over the Mackinaw river at Morrismill ford.

Selin's Grove, Pa.—The viewers have decided to build a bridge across the Susquehanna river, between Herndon and Port Treverton.

Madison, Neb.—Sealed bids are asked until March 18 for all pile and iron bridges to be built during the year. Phil Bauch, co. clk.

Jamestown, Ind.—The county commissioners have been petitioned to biuld a bridge across Bango creek, between Wakarusa and Jamestown.

Parker, S. D.—Bids are asked until March 4 for a steel bridge over Vermilion river, Marion twp. Joseph J. Waltner, Jr., co. audt

Concord, N. H.—A bill has passed the legislature authorizing the construction of a free bridge across the Connecticut river at Dalton.

Perth Amboy, N. J.—A committee has been appointed to consider plans for a bridge over the Raritan river between this city and South Amboy.

Delphi, Ind.—Sealed bids are asked until March 4 for building an approach to a bridge in Burlington twp. John Nevin, chmn. co. com's.

Chillicothe, O.—Sealed bids are asked, until March 5, for a 135-ft. bridge over the north fork of Paint creek. A. W. Jones, co. surv.

Hardin, Ill.—Bids are asked, until March 18, for the steel superstructure of a bridge over Crawford Creek. Chas. Flamme, co. clk.

Rowlesburg, W. Va.—Bids will probably be asked next summer for a steel bridge over Cheat river. Geo. H. Walls, clk. co. court, Kingwood.

New York City.—Surveys and plans have been made by Engineer Schenck for a steel plate girder bridge across East Charter creek, in Pelham Bay Park.

Columbus, O.—Sealed bids are asked, until March 13, for substructures, superstructures and paving of certain bridges. L. E. Jones, co. audt.

Lowell, Mass.—The street committee voted to instruct the city engineer to prepare plans for a 50 ft. bridge to replace the present Pawtucket bridge.

Chatham, Ont.—Bids are asked, until March 8, for constructing a steel trestle approach to a bridge across the Thames river in Kent county. J. C. Fleming co. clk.

Rensselaer, Ind.—Plans and specifications for two bridges in Marion twp. and one each in Walker, Jordan and Newton twps., will be prepared by G. P. N. Saddler.

Grand Rapids, Mich.—Sealed bids are asked, until March 8, for constructing Bridge-st. bridges over East and West Side power canals. Dudley E. Waters, prest. B. P. W.

Michigan City, Ind.—Bids will be received until March 14 for constructing a drawbridge to span the harbor at Seocnd-st. Francis H. Doran, Co. Audt., Laporte, Ind.

Defiance, O.—Sealed bids are asked until March 11 for the construction of two stone abutments for a bridge across Tiffin river, in Noble twp. Peter Coressel, chmn. co. coms.

Atlantic, Va.—The board of local improvements has given the West Ghent company permission to construct a bridge 300 ft. long across Farrants creek, at an estimated cost of $12,000.

Duluth, Minn.—Bids are asked, until March 25, for the construction, operation and maintenance of a ferry bridge across the ship canal, at Lake-ave. T. W. Hugg, chmn. special ferry br. com'n.

Nashville, Tenn.—The committee has submitted estimates to Mayor Head for a bridge across Cumberland river, at Broad-st., as follows: Low bridge, with a draw, $282,500; high bridge, without a draw, $386,700.

French Indo China.—Bids will be received until May 9 by the director of public works for Cochin China, at Saigon, for a bridge over the Arroyo Chinais. For particulars address Inspector-General of Colonies, Ministry of the Colonies, Paris, France.

Frankfort, Ind.—Sealed bids are asked until March 5 for the construction of a number of steel bridges. Bids will be received until March 18 for the construction of stone abutments and substructures for these bridges. Wm. H. Jenkins, chmn. bd. co. comrs.

Indianapolis, Ind.—Contracts for three bridges have been awarded as follows: Big Eagle Creek in Reveal road, Indianapolis Bridge & Iron Works, $5,498; Big Eagle Creek bridge, Crawfordsville pike, American Bridge company, New York City, $4,175; White river bridge at Broad Ripple, super-

structure, American Bridge company, $17,295, substructures, $9,828.

Cincinnati, O.—Plans have been approved for a steel viaduct across the railroad at Delta river. The viaduct proper will be 842 ft. long, with an eastern masonry approach of 45 ft., and a western approach of 48 ft., making a total of 9,395 ft. The roadway will be 38 ft. wide and paved with asphalt, with 7-ft. stone flagging sidewalks; estimated cost, $175,000.

PARKS.

Macon, Ga.—The improvement of Tatnall Square park is proposed.

Atlanta, Ga.—A new park near Davis-st. school is contemplated by this city.

Huntsville, Ala.—The establishment of a handsome park is contemplated by the Huntsville electric street Railway Light & Power company.

A circular regarding Michigan wild flowers for summer planting, which has been issued by Wilfred A. Brotherton of Rochester, Mich., is of special interest to those in charge of parks and cemeteries.

STREET LIGHTING.

Bridgeport, Conn.—A municipal light plant is proposed.

Avoca, N. Y.—A municipal electric light plant is proposed.

Sioux City, Ia.—A hot water heating plant is contemplated.

Odebolt, Ia.—An electric light and hot water heating plant is contemplated.

Liveoak, Fla.—Bids are asked until March 18 for constructing an electric light plant. C. Y. Byrd.

Chattanooga, Tenn.—Plans will be prepared at once for the proposed plant. W. I. Williams, chm. com.

Batavia, N. Y.—Dr. Richardson and F. I. Judd have petitioned for a franchise to pipe the streets and furnish gas

The question of issuing bonds for electric lights has been favorably voted on at Charlemont, Mass.

Geddes, S. D.—Bids are desired for a complete plant of 800 to 1,000 lights. G. W. Morrow, secy. Geddes Light and Water company.

Suffolk, Va.—Bids are asked until March 15 for lighting the streets and public buildings. W. N. McAnge, chmn. com on lights.

Ft. Adams, R. I.—Bids are asked until March 14 for an electric light plant. Maj. Geo. W. Gottals, U. S. Engr., Newport, R. I.

Tarrytown, N. Y.—The question of building a municipal light plant will be voted on soon, according to press reports.

Bills have been passed in the legislature authorizing the issue of bonds for electric light plants as follows: Clayton, Ala.; Roanoke, Ala.

Galion, O.—A franchise will probably be given to the Delaware Electric Light, Heat and Power company, to heat this city by a hot water system.

Hampton, Va.—Mayor Hope has been authorized to appoint a committee to investigate the question of establishing a municipal electric light plant.

Lexington, Miss.—Bids will be desired about April 1 by the Ice, Light and Water company for erecting a 100-K. W. plant. E. C. DeLang, mgr.

Manning, Ia.—The question of granting a ten-year franchise will ve voted on the last Monday in March.

Portland, Me.—Sealed bids are asked until March 11 for an electric light plant for Ft. Williams, Me. S. W. Roessler, maj. engrs.

Creston, Ia.—A five-year contract has been awarded the Creston Gas and Electric company for furnishing 23 arc lights of 2,000 c. p. at $76 per light per year.

Rochester, N. Y.—Bids are asked until March 15 for an engine, generator, switchboard and pole line at the Rochester state hospital. Fred Cook, pres. bd. mgrs.

Port Austin, Mich.—Bids are asked until April 1 for furnishing one 500-lgt. dynamo, 1,000 incandescent lamps, etc., for the proposed municipal plant. W. L. Larned.

Ripon, Wis.—Bids are asked until March 5 for a franchise for an electric light plant for 5 to 15 years; also furnishing 110 incandescent and 7 arc lights. T. W. Allen, cy. clk.

Oshkosh, Wis.—Mayor Mulva, Aldermen Weisbrod, Newman, Simpson and Warren comprise a committee to investigate the best and cheapest method of lighting the streets and bridges of this city.

Pekin, Ill.—The Pekin Light, Heat and Power company has been granted a 25-year extension of their franchise, in consideration of which the company has reduced the price of arc lights from $85 to $65 per month.

York, Pa.—The contract for lighting the city for one year was awarded to the Edison Electric Light company of this city at 20½ cents per light per night, for every night and all night for 288 2,000 c. p. arc lights or more.

St. Joseph, Mich.—According to local press reports fifteen business men will build and donate to the city a $15,000 electric light plant if the common council will give them $70 a light for three years for street illumination, the plant to be transferred to the city at the end of that time.

The question of issuing bonds for the construction of electric light plants will be voted on at the following places: Maple Lake, Minn.; Hedwig, Ia., March 4; Guthrie, Ia.; Lamberton, N. C., March 1; Carsonville, Mich.; Dublin, Ga., March 12; Napoleonville, La.; Jonesboro, Tenn.

Syracuse, N. Y.—The board of contract and supply awarded a five-year contract Feb. 11 to the Electric Light and Power company at 23½ cents a night for arc lights and 8 cents a kilowatt for incandescent lighting for city buildings. Justice W. C. Scripture immediately granted an injunction restraining the mayor and electric light company from signing this contract.

The construction of electric light plants is contemplated at the following cities and towns: Ellisville, Miss.; Sisseton, S. D.; Tacoma, Wash.; Chatham, N. J.; Ravenswood, W. Va.; Dickson, Tenn.; Lincoln, Ill.; Weir City, Kas.; Provincetown, Mass.; Hawkinsville, Ga.; Scotland Neck, N. C.; Scribner, Neb.; McIntosh, Minn.; Menasha, Wis.; Talladega, Ala.; Thorp, Wis.; Tiskilwa, Ill.; Toledo, Ill.; Johnstown, O.; Lompoc, Cal.; Pennville, Ind.; Red Lion, O.; River Rouge, Mich.; Midway, Ky.; Frederickstown, O.;

Greensboro, N. C.; Hammondsport, N. Y.; Hampton, Va.; Hogansville, Ga.; Archbold, O.; Fulton, N. Y.; Sherrard, Ill.; Kinsley, Kas.; Winona, Minn.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

Montreal, Quebec.—The question of building an incinerator in the East End is being considered.

Elgin, Ill.—The council has appropriated $5,000 for a garbage crematory, according to press reports.

Chester, Pa.—Rates will be asked soon for cleaning the paved streets, and for garbage collection, Cy. clk.

Pawtucket, R. I.—Bids will be received March 6 for the removal of dead animals, etc., for a term of five years. Cy. clk.

Lowell, Mass.—Councilmen Browneau, Clark and Legare have been appointed a committee to consider a better method of disposing of the garbage waste, etc.

Brantford, Ont.—Mayor Wood, A. F. Vaughan, Joseph Bowes and D. J. Monahan have been appointed a committee to secure estimates for a garbage disposal plant.

Nashville, Tenn.—A resolution has been adopted providing that a committee be appointed to investigate and arrange a better system for disposing of the city's garbage.

Pawtucket, R. I.—The purchase of at least three new sprinkling carts during the coming season is recommended in the annual report of the board of public works. Wm. H. Bravely, com'r. pub. wks.; Geo. Carpenter, cy. engr.

Waukesha, Wis.—Sealed bids are asked until March 2 for two street sprinklers complete of 600 gals. each, with platform springs and a 4-in. tire, spray sprinklers and interchangeable parts. John P. Dey, chmn. B. P. W.

Detroit, Mich.—Sealed bids are asked until March 11 for collecting and disposing of the garbage of the city for terms of 3, 5, 7 and 10 years. Separate bids will also be received for the collection of garbage and for the disposal of garbage. F. A. Blades, controller.

Chicago, Ill.—A new municipal cleanliness ordinance was passed Feb. 18, which provides for two sets of wagons—one with a box of metal, waterproof and the other of the ordinary wooden variety. Garbage and other discarded material that is not classed as ashes will be thrown in the metal wagon and ashes in the ordinary wagon.

Atlantic City, N. J.—Bids were received Feb. 11 for a crematory as follows: Cramp & Co., Philadelphia, foundations, platforms, etc., $14,715; Henderson & Co., Philadelphia, foundations, platform, etc., $15,400; gas producer, $22,915; M. P. Wells & Co., Philadelphia, foundations, platform, etc., $18,118; Machin & Brown, Philadelphia, foundation, platform, etc., $13,887; gas producer, $22,137; the Hix & Sons company, Bridgeton, N. J., gas producer, $22,915.

TOO LATE FOR CLASSIFICATION

North Toronto, Ont.—A new water works system is contemplated.

Geddes, S. D.—A water works and electric light system is proposed.

Armour, S. D.—The construction of a sewerage system is contemplated.

Hopkinton, Ia.—The question of building water works is being revived.

Springfield, Mass.—This city contemplates doing its own street sprinkling this year.

Sparta, Wis.—The question of street paving will probably be voted on.

Minneapolis, Minn.—A new bridge across the Mississippi at Washington-ave. is proposed.

Berryville, Va.—The question of establishing an electric light plant is again being agitated.

Terre Haute, Ind.—An appropriation of $45,000 is proposed to build a new wagon bridge across the Wabash river.

Indianapolis, Ind.—Notice of intention has been published for building a sewer in W. Michigan-st. Albert Sahm, chmn. B. P. W.

St. Paul, Minn.—Preliminary orders were passed, Feb. 19, for paving Rice-st., from College to Front-st., with asphalt.

Bay City, Mich.—(Special.)—Geo. Turner, cy. engr., says 50,000 sq. yds. of brick paving on concrete foundation is contemplated.

Los Gatos, Cal.—The property owners in the Almond addition of this city will petition the town board of trustees for a sewerage system.

Dallas, Tex.—The water commissioners are not satisfied with the bids received for cleaning the reservoir site, and will probably readvertise.

Baltimore, Md.—Sealed bids are asked until March 11 for vitrified brick and rubble stone street paving. John De P. Douw, chmn. com. on sts.

West Duluth, Minn.—Bids will be asked soon on different kinds of material for paving Central-ave. Asphalt and creosoted block seem to be most favored.

Chicago, Ill.—Sealed bids are asked until March 4 for constructing cement sidewalks in portions of 49 streets. L. E. McGann, prest. bd. local impvts.

Knightstown, Ind.—The contract for a new electric light plant was awarded, Feb. 18, to the American Water and Light company of Indianapolis for $8,416.77.

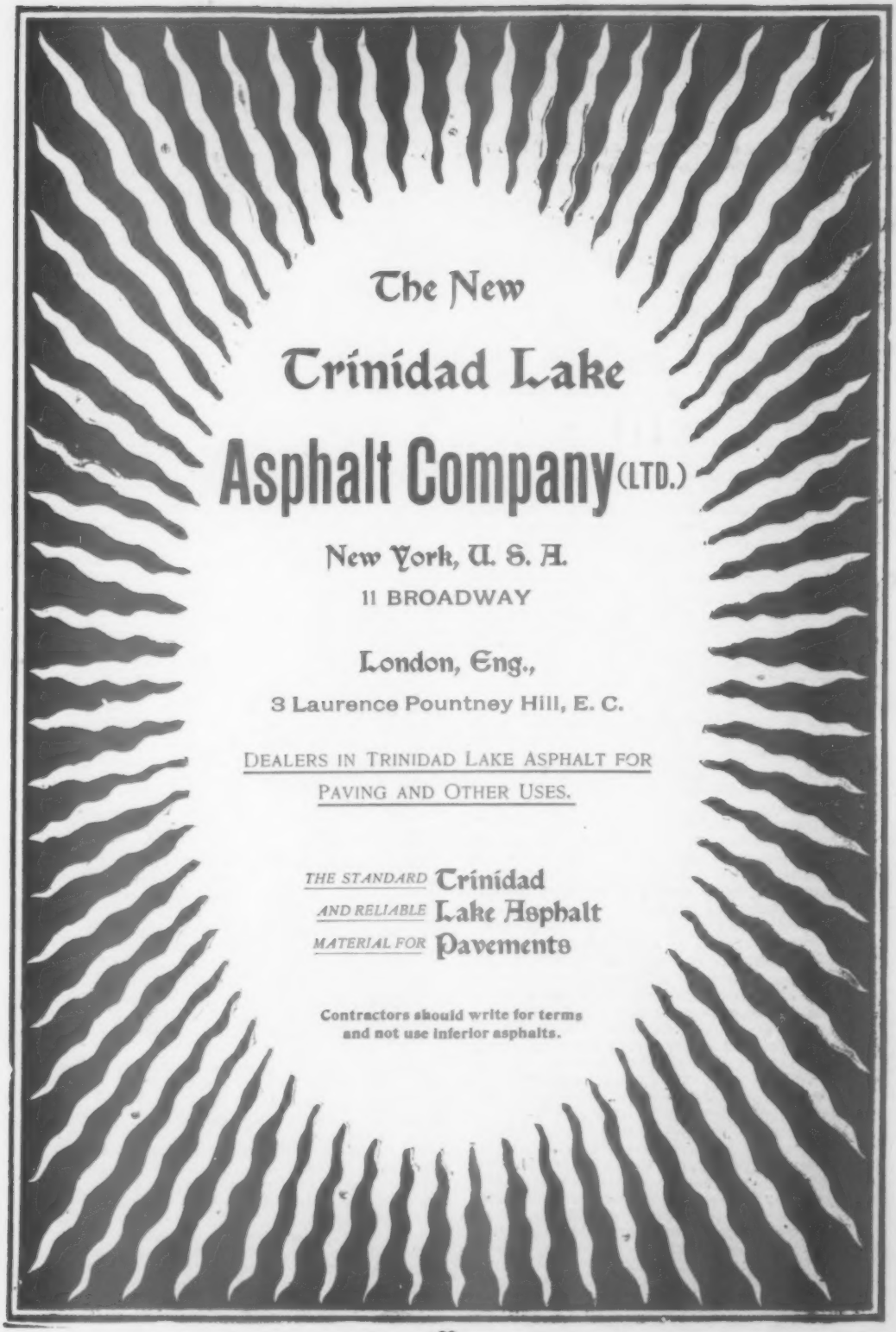
Mackinac Island, Mich.—A franchise for water works, a sewerage system and an electric light plant was granted, Feb. 14, to Frank C. Andrews and associates.

Kenosha, Wis.—Sealed bids are asked until March 4 for constructing 9,552 ft. of 15 and 12-in. pipe sewer, 5 manholes and 4 catch basins. Gus Jacobs, cy. clk.

Troy, N. Y.—The question of public parks is being discussed. The contract for the extension to the water works was awarded, Feb. 19, to Martin Murray & Co., of this city for $8,044.95.

St. Louis, Mo.—An ordinance was approved Feb. 19 authorizing the construction of a covered reservoir on the water works property at Baden, and $260,000 has been appropriated for the purpose. Water com'r. Flad.

Buffalo, N. Y.—Sealed bids are asked until March 6 for paving Kingston place, Ryan and Sobieski-sts., and Yale place, for repairing Ohio, Hamilton, East, Seventh and Commercial-sts., and for macadamizing Florence-ave. R. G. Parsons, secy. B. P. W.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